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To Advertisers

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to ensure publication in that week's issue.

THE BALTIMORE, WASHINGTON & ANNAPOLIS SINGLE-PHASE ROAD.

We have already mentioned the projected single-phase railroad between Baltimore, Washington and Annapolis. Last week we give a somewhat fuller statement of the plans of the company.

The greatest novelty in the equipment of this road will be the use of single-phase motors. How these are to be applied has not yet been given out, and further announcements will be awaited with special interest. It has been the rather generally accepted opinion that the electrical manufacturing companies in this country had decided that the polyphase induction motor was not suitable for railway work, and that the single-phase motor was not even considered.

The performance of this road will be closely watched, both at home and abroad, and a substantial success will redound greatly to the credit of the promoters of the road and to the company which equips it, and will undoubtedly hasten the day when all passenger trains, at least, will be operated electrically.

THE MEETING OF THE AMERICAN ELECTROCHEMICAL SOCIETY.

The second general meeting of the American Electrochemical Society, held at the International Hotel, Niagara Falls, N. Y., September 15-18, was even more successful than the Philadelphia meeting. The excellent attendance caused a good deal of surprise and pleasure. Out of a little over four hundred members there were over one hundred and thirty in attendance, and this does not include a number of guests present who are applicants for membership. While undoubtedly the selection of Niagara Falls for the meeting place was a factor in drawing such a full attendance, the facts that the meetings were so fully attended and so much enthusiasm was shown over the society and its work should not be overlooked.

The papers presented, both in their number and character, offer encouraging assurance of what may be expected from the members. The subjects considered covered a wide range and included reports of highly scientific research work as well as practical technical applications. The discussions in general were satisfactory, but there can be no doubt but that they would have been more valuable and interesting if it had been possible to have the papers printed and distributed somewhat in advance. While this arrangement is to be hoped for in the future, the committee on papers deserves commendation upon its success in securing contributions from so many members, and it was hardly to be expected that these could be got into print at this time.

As was announced, a number of the works located at Niagara were thrown open to the society for inspection. It is true that this was not done as generally as had been hoped, but as pointed out by President Richards, the companies that did not do so were certainly within their rights and should not be criticised. We hope, however, that they will think better of their decision before the next time the society meets at Niagara.

The pleasure trips also were most successful and enjoyable. The local committee spared no pains in its arrangements and deserves the thanks of the society for the perfection of its plans and the smoothness with which they were carried out.

One small feature of the organization was admirable and deserves mention. The members were numbered serially as they registered and given badges with these numbers on them. Then a list of the members registered and their numbers was printed and distributed This enabled members who did not know each other personally to seek each other out and immediately identified any one connected with the society.

As shown in the report of the meeting on Monday, the society is in excellent financial condition in spite of its small membership fee and its comparatively small numbers. The splendid success of the meeting is exceedingly gratifying to those who have been interested in electrochemical matters for some time, and who have heretofore deplored the fact that no united effort was being made in this country to advance the science and application of this branch of applied electricity, or is it applied chemistry?

ACCIDENTS ON TROLLEY ROADS.

The too frequent occurrence of accidents on electric roads has recently provoked some severe criticism of the trolley systems. However much this may be deserved, the blame should be put where it belongs, and not on the method of transportation. These alleged abuses are not due to the method of propelling the cars, but to the manner of operating the road.

The greatest number of electric roads were developed from tramways, and these assume that they retain all the privileges

enjoyed by the latter without incurring the restrictions imposed upon the steam roads which they more closely resemble.

Such abuses as are charged can be corrected by legislation, but this ought not to be necessary, for legislative action may be carried too far and really injure the roads. All the necessary precautions for the protection of the public should be adopted by the managements of the roads on their own initiative, and the sooner this is realized the better.

But aside from all questions of the proper measures to be taken in this matter, it is not just to charge against the trolley system those faults arising from improper management. Any other method of transportation as flexible, and having a development as rapid as the trolley, would have brought the same troubles.

ELECTRICITY AND THE WORLD'S FAIR.

To the mind of any one who has followed the development of the plan for a universal exhibit, electrically, at the St. Louis Exposition of 1904, it is apparent that no effort is being neglected to arouse and maintain enthusiasm of the right sort. At each convention where electrical interests of any prominence have been present the matter has been ably set forth in a timely and direct fashion. And those who have heard of the ample provision which has been made for a truly electrical exhibit have not been lacking in a realization of the opportunity awaiting to expose to the world a positive view of the advance made in electrical conditions since the World's Fair at Chicago, and even since that notable exploitation of electrical marvels at Buffalo.

Within the last few months resolutions in support of the work being done at St. Louis for the proper recognition of electrical exhibits at the World's Fair of 1904 have been passed by the National Electric Light Association, the Independent Telephone Association, the American Electrotherapeutic Association, and the American Electrochemical Society. Outside of these representative organizations the cause should be afforded the support of every one connected in the remotest way to the electrical industry.

RELATION OF ELECTRICAL APPLICATION TO OUR COAL SUPPLIES.

In view of the scarcity of coal caused by the coal strike, it may be an interesting question to some whether or not we are less dependent upon that commodity than before the extensive developments in electrical fields. How far also, if at all, would electricity help us in the case of a prolonged coal famine or the exhaustion of the coal supply, this latter contingency being, in spite of the fears of some, an event which is scarcely likely to embarrass this generation or its immediate successors.

It is hardly necessary to say that electricity in itself is not a source of energy. Rather is it a method which enables us to use up more rapidly the supplies we have on hand. Its chief merit lies in the ease with which it can be transmitted and transformed into other forms. It is to the world of power what a draft is to the business world, a convenient method of exchange, although there is generally a commission to deduct at each end of the transaction.

But in just the measure we facilitate the consumption of fuel, the amount consumed will be increased. Electrical methods, although in general they are more economical than other ways of utilizing energy, are not saving us coal. Indeed they are enabling us to use it at an increasing rate.

So far as considered we see that the applications of electricity, while undoubtedly allowing us to get more out of our coal on account of the efficiency of many of the electrical methods, are not conserving our coal supply, but rather using it at a much greater rate than ever before.

Whatever has been said in regard to coal will, of course, apply equally well to all other fuels. Thus the discovery of the oil fields of California and Texas has merely postponed the day when our fuel will be exhausted.

Fortunately, however, coal is not our only source of energy. We have the vast number of waterfalls, still to a great extent undeveloped, and these are inexhaustible as long as the present climatic conditions prevail, that is to say, the supply of water will not fail.

Coal represents energy received from the sun millions of years ago. The power of the waterfalls represents energy received from the sun yesterday.

In the development of our water powers, however, electrical methods are at their best. Not until we brought these into their present highly advanced condition have we been able to utilize to the fullest extent these hydraulic sources of energy. Now we are able to avail ourselves of these falls, transform the hydraulic energy into electrical energy, transmit this to great distances and retransform into useful forms of energy—mechanical, light or heat.

In just the extent in which we develop our water powers will we be independent of the coal supply. By this means we can perform all our mechanical work, light and heat our buildings and replace to a large extent the fuel in our many forms of furnace. All the heat required for these could be supplied electrically, though at present this is not an economical method of using electrical power simply because the demand for this power for other purposes makes it more expensive when used in this way than coal. The conversion of the chemical potential energy of coal into heat in a furnace is a very efficient process. It is when we convert this energy into another form by an application of the second law of thermodynamics that the transformation process becomes inefficient.

The proper use of our coal supplies would therefore be to preserve them entirely for heating and reducing agents in chemical processes, using water power for all other purposes.

Under exceptional conditions coal might be used to help over the peak of the load, just as at present accumulators are used to store up the output of the power station at times of light load, only to give it out again when the load on the station is at its maximum. However, the construction of suitable reservoirs in connection with the hydraulic plant would effect the same purpose and enable every cubic foot of water to be used to its fullest extent. Undoubtedly the day when this

condition will prevail generally is far distant, but some such course will certainly become necessary in time to come.

MUNICIPAL OWNERSHIP.

From time to time we have taken occasion to criticise the efforts of those who, with misdirected zeal, endorse the municipal ownership of corporations which have from the time of their inception proved more successful under private operation. Commenting on this subject, the Oswego (N. Y.) *Times* makes the following remarks:

"That very careful and expert publication, the New York ELECTRICAL REVIEW, has this to say of municipal ownership of electric lighting plants:

"'Probably there is no city of between ten thousand and one hundred thousand inhabitants which has not already undergone at least one period of agitation in favor of municipal ownership of electric lighting plants. Just why this particular business has been seized upon for the exploitation of socialistic theories is hard to find out. The majority of aldermen and councilors understand the grocery business, or think they do, and it would seem that this widespread, necessary and important branch of trade might claim their attention rather than electric lighting, which they know nothing about and which has the further disadvantage of being a business requiring very expert management. Yet, so far as we know, there has been no movement made anywhere to establish the grocery business on lines of municipal ownership. The whole thing is a dark mystery, and the only really pleasing thing about it is that cities afflicted with the agitation recover their senses after a time—slowly if the plant is not erected, very swiftly and repentantly if it is.'

"These are words worth treasuring up against the time when this city shall have an uncontrollable impulse to venture on an experiment of this kind, to the extent, at any rate, of going about it with a circumspection that most places apparently do not exercise at the beginning."

ELECTROCHEMICAL INDUSTRIES.

The first issue of *Electrochemical Industries* has been received. The new journal, as its title indicates, is devoted to the science and application of electrochemistry.

Among the valuable features of the journal are the following: A digest of United States electrochemical patents prior to July, 1902, and an analysis of current patents; a synopsis of articles on electrochemistry appearing in other journals, and a series of biographical sketches of pioneers in electrochemistry.

We extend to *Electrochemical Industries* a warm welcome and best wishes for a long and successful life.

CHECKING ELECTRICAL INSTRUMENTS.*

BY CLAYTON H. SHARP.

About a year ago an editorial article appeared in the *Electrical World and Engineer* entitled "Wanted: a Volt." In this article the editorial writer made the point that if some one were to make a collection of all the different kinds of volts which are being solemnly registered by voltmeters in central stations and in isolated plants throughout the country, such a collection would be very remarkable, if not for its beauty, then at least for its variety; and that what is really needed is a volt, not several different kinds of volts. That such a state of affairs as hinted at above exists is probably traceable to two causes, one of which is too much blind reliance on the indications of direct-reading instruments which are liable to be wholly unregenerate or to have fallen from grace, and the other a disinclination, let us say, to take up with and use such simple and reliable means and methods as can be had for detecting all vagaries. It is the purpose of this paper to indicate a simple system for keeping the principal instruments of a central station or of a testing room properly checked.

DIRECT-CURRENT VOLTMETERS.

Undoubtedly the best arrangement for checking a voltmeter as well as for the accurate measurement of steady direct-current potentials in general, is the potentiometer used with a standard cell. In its complete form the potentiometer is a somewhat expensive and complicated instrument, such as can not be placed in the hands of a person untrained in its use. It is possible, however, greatly to simplify the design of the potentiometer when the requirements which it has to fulfill are correspondingly simplified, and, that, too, without detriment to its accuracy.

In central stations only a few voltages need be cared for. A potentiometer suitable for reading only a few voltages can be made very simple in construction and in operation. Such a potentiometer may be used in connection with a voltmeter to keep all the pressure employed in the station checked up. The scale of the voltmeter should be calibrated once for all so that the variation of its correction at all required points is known, after which a determination of the absolute value of its correction at one or two points suffices to give its correction at all points.

Simple Potentiometer—A diagram of the circuits of a simple potentiometer intended to measure only one definite voltage is given in Fig. 1. The voltage to be measured is brought to the binding-posts, A and B, which are connected by coils of high resistance—100,000 ohms or higher. From a suitable point, D, of the coils a tap is brought out to the binding-post, D^1. D is so chosen that the resistance, AD, bears the same ratio to the resistance, AB, as does the electromotive force of the standard cell to the electromotive force to be measured.

The standard cell, C, is connected to A through the binding-post, E, and the key, K, and is connected to D^1 through the galvanometer, G, and the high resistance, R. The latter is intended for the protection of the cell against anything approaching a short-circuit, and may be itself short-circuited at P when the potentiometer has been nearly balanced. If A is connected to the positive side of the circuit, the positive terminal of C is connected to E, and *vice versa.*

If connections are made as described, when the proper electromotive force is applied to AB, and the key, K, is depressed, the galvanometer shows no deflection. If, on depressing the key, a deflection is noted, the electromotive force on AB must be adjusted until the deflection is reduced to zero. If a voltmeter is connected in multiple with AB and a reading of it is taken at the time the above adjustment is secured, the value of its correction is obtained at once.

If it is desired to arrange the potentiometer to read more than one voltage, more taps similar to DD^1 are added. It is an advantageous arrangement to have the potentiometer read three or more voltages which are multiples of each other, such as 58, 116 and 232. These voltages cover the principal ranges for incandescent lamps. Now, if two cells which agree with each other in the indication of any one voltage are connected in series

*Paper read before the Association of Edison Illuminating Companies, Mt. Washington, N. H., September 9, 1902.

on the fifty-eight-volt point, they should give the same indication as does one cell alone on the 118-volt point. Thus the accuracy of the potentiometer can be partially checked.

The Clark standard cell has a large temperature coefficient, the variation of its electromotive force amounting to nearly 0.1 per cent per degree centigrade. It is consequently necessary, in using a potentiometer with this cell, either to apply a correction to its indications corresponding to the temperature of the cell, as can readily be done from a table of corrections, or to construct the potentiometer so that these variations can be compensated for.

A diagram of a three-point potentiometer, with compensation for temperature, is shown in Fig. 2. Here a series of taps is brought out from the resistance, AB, to contact studs, over which a switch contact, G, sweeps. Each of the studs is marked with the temperature of the Clark cell to which it corresponds, hence, in making measurements, it is necessary only to set G on the proper stud to get results which need no correction for cell temperature.

This potentiometer may be further extended to make it a self-contained, portable instrument. To this end a pivoted galvanometer of the moving coil type, of high resistance and strongly damped, together with three portable standard cells, is enclosed in the same box with the resistance coils. When this is done, outside posts should be provided for connecting the cells either singly or in series, and for using, if desired, an outside cell and galvanometer.

A portable three-point potentiometer of this type has been in use by the lamp testing bureau for some time, and has given very satisfactory results. The sensitiveness of the little galvanometer is such that voltages can be read to 0.1 per cent. It possesses among other merits that of great simplicity in construction and use, consequently it requires no especial skill to operate it. Any person who can read a voltmeter accurately, can be taught in a short time to use the potentiometer.

The calibration of the voltmeter throughout the scale can, of course, be done only by using a regular potentiometer or its equivalent.

Standard Cells—There are but two classes of standard cells which need to be considered to-day—the Clark cell and the cadmium or Weston cell. The Clark cell has electrodes of mercury and of zinc or zinc amalgam in a saturated solution of zinc sulphate, with mercurous sulphate as a depolarizer. The legal value for its electromotive force is 1.434 volts at fifteen degrees centigrade. Its electromotive force decreases 0.0012 volt for each degree rise in temperature. This large temperature coefficient, amounting to nearly 0.1 per cent per degree, is not the only disadvantage under which the Clark cell labors. It has been found also that changes in the electromotive force of the cell do not instantly follow changes in its temperature. This time lag is particularly noticeable in the ordinary Board of Trade or test-tube form of cell. In Lord Rayleigh's H form, and in the inverted test-tube form in which the zinc amalgam is placed at the bottom of the tube, this effect is much smaller and quite negligible in all ordinary work.

Professor Carhart has designed a form of Clark cell in which the solution of zinc sulphate, instead of being saturated at all temperatures, is saturated at 0 degree centigrade. This form has a considerably smaller temperature coefficient than the

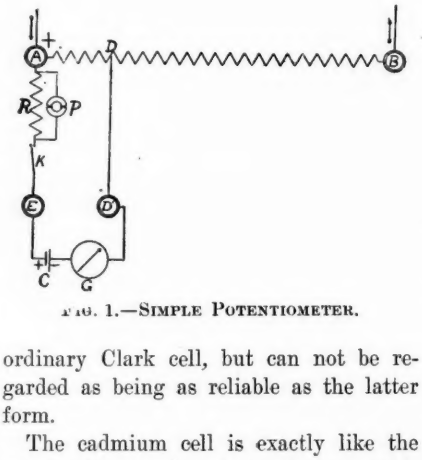


FIG. 1.—SIMPLE POTENTIOMETER.

ordinary Clark cell, but can not be regarded as being as reliable as the latter form.

The cadmium cell is exactly like the Clark cell excepting that cadmium amalgam and cadmium sulphate are used instead of zinc amalgam and zinc sulphate. This results in a cell of smaller electromotive force and of much smaller temperature coefficient than the Clark cell. If we accept the value of the electromotive force of the Clark cell given above, the electromotive force of the saturated solution cadmium cell is 1.0194 volts at twenty degrees centigrade. Its temperature coefficient is only 0.000038 volt per degree. The reliability of the cadmium cell is, according to the physicists of the German Reichsanstalt, quite as great as that of the Clark cell. My own experience leads me to believe that it is decidedly more difficult to construct a cadmium cell which shall give the right electromotive force than it is to construct an accurate Clark cell. The smaller temperature coefficient of the cadmium cell, which is negligible in most technical work, makes it more convenient to use than is the Clark cell.

The Weston cell follows Professor Carhart's plan in that its cadmium sulphate solution is saturated at four degrees centigrade only. Its electromotive force does not differ very much from that of the saturated solution cadmium cell, and should be determined by comparison with a saturated solution cell. Its temperature coefficient is for nearly all purposes, even of precise measurement, quite negligible.

To secure the utmost reliability in the indications of a standard cell, certain simple precautions need to be taken. The most important thing is to avoid drawing any appreciable current from it. A current passing causes polarization in the cell and diminishes its electromotive force. If, by accident, a cell has become polarized by being short-circuited, its usefulness is by no means at an end, since, if it is properly constructed, it will come back to its normal electromotive force in the course of a few hours or days. The potentiometer method, being a zero method, makes no demands on the cell for current when once a balance has been secured. Until such a balance has been nearly secured, a high resistance should be included in the cell circuit.

In order to secure the best results from the Clark cell it should be protected from all sudden changes in temperature. Immersing the cell in a large bath of liquid has the effect of diminishing the speed of temperature changes, and also enables the temperature of the cell to be determined accurately by immersing a thermometer in the same bath. This is a refinement which need hardly be gone into in technical practice, especially if the H or the inverted test-tube form of cell is used, since any fluctuations due to lag of the electromotive force would not be likely to exceed 0.1 per cent.

For absolute certainty it is advisable to have three or more cells, which are checked against each other. If three cells which are known to have been accurate and found at any time to be in substantial agreement, that is, if they do not differ from each other by more than a few ten-thousandths of a volt, it is almost certain that they are right. It is better to use only such cells as have been compared with standards of known accuracy. The electromotive force of such cells may be relied upon as being within a few hundredths of one per cent of its nominal value. The adjustment of the resistance in the construction of the potentiometer can be carried out to a similar degree of

accuracy, which becomes consequently the measure of the accuracy attainable with the potentiometer method.

DIRECT-CURRENT AMMETERS.

The best way to measure current strength accurately is (if we leave the silver voltmeter out of account) by finding the potential difference between the terminals of a conductor of known resistance through which the current flows. Suitable conductors for this purpose are made of manganin, an alloy which has a very low-temperature coefficient of a resistance as low as one ten-thousandth of an ohm, and calculated to carry as much as 2,000 amperes without undue heating. The measurement of the potential difference must be made with a complete potentiometer. This arrangement has great advantages over the Kelvin balance and the chemical voltmeter, of being much less troublesome to manipulate, and of not requiring a perfectly steady current.

A modification of this method, which is very suitable for checking ammeters, consists in the substitution for manganin low-resistance standards, high-resistance standards in the form of incandescent lamps. These lamps are standardized, not by determining their resistance, but by measuring very carefully their current consumption at a given voltage or series of voltages, using the standard resistance and potentiometer, or any other good method of current measurement.

Good lamps should be selected for this purpose, and these should be carefully and cautiously seasoned to the point that they can be relied upon to change only very slowly with age. To secure durability, the temperature at which they are operated should not be higher than that corresponding to four watts per candle, but it should not be so low that the resistance of the filament is appreciably influenced by changes in room temperature. They should be standardized for current consumption at a voltage which the station potentiometer indicates.

Lamps which are so prepared and which are never subjected to a voltage higher than that for which they are standardized constitute very permanent and reliable standards of as high accuracy as may be desired.

A series of such lamps may be selected which, when operated in multiple in various combinations, will cover a wide range of current values with very small steps from one value to the next. Table I gives a theoretical series of ampere lamps by which any current may be measured from 0.05 ampere up to the limit of the series with 0.05 ampere steps. The series is so arranged that the lamps may be checked against each other, and any lamp which shows any tendency to change may be detected.

TABLE I.

Theoretical Series of Ampere Lamps.

Number of Lamps.	Current at Given Voltage.
2	0.05 Amp.
1	0.10 "
2	0.20 "
1	0.50 "
1	1.00 "
2	2.00 "
1 or more	5.00 "

It would, of course, be impracticable to attempt to secure a series of lamps which would fit exactly the above series. The values given can only be approximated to in commercial lamps, but since an ammeter does not need to be checked exactly on even scale divisions, this fact does no harm. As showing how near to

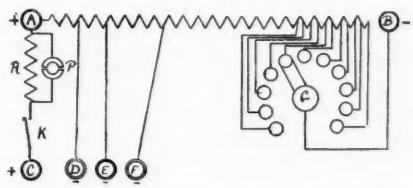


FIG. 2.—THREE-POINT POTENTIOMETER.

the above values we may come with commercial lamps, data are given in table II on a series of ampere lamps in the possession of lamp testing bureaus.

TABLE II.

Actual Series of Ampere Lamps.

Amperes at 116 Volts.	Amperes at 116 Volts.
0.0519	1.005
0.0515	0.924
0.1008	2.093
0.1181	2.070
0.215	3.430
0.191	3.483
0.506	.....
0.499	.....

It is quite probable that by sampling a larger variety of lamps nearer approach to the theoretical series could be obtained, but it is doubtful if any gain would result. A lamp with higher current consumption than 3.5 amperes would, however, be useful.

ALTERNATING-CURRENT VOLTMETERS.

These can best be checked by comparing them with a standardized direct-current voltmeter through the medium of an inductionless transfer instrument. Probably the best transfer instrument is an electrostatic voltmeter, although a hot-wire voltmeter, the series resistance of which has been wound to avoid inductance and capacity, can be used with good results. Instruments of both these types are in use by lamp testing bureaus.

The hot-wire voltmeter is a specially sensitive one constructed by the Stanley Electric Manufacturing Company, one-tenth of a volt being easily readable on its scale. This voltmeter is calibrated by bringing it in multiple with a Weston laboratory standard direct-current voltmeter, which has been checked by a three-point potentiometer. The pressure is adjusted to the point at which a check is desired, and the error of the hot-wire voltmeter is determined. The alternating-current pressure is at once thrown on to the hot-wire instrument and the check is obtained. For greater security the direct-current readings may be remade after the alternating-current measurements.

With steady pressures, both alternating current and direct current, quite a close check can be obtained in this way. On account of its high sensitiveness, the range of this instrument is small, from 110 to 120 volts only. The resistance in series with the wire seems not to be entirely free from reactance, as the indications are from 0.05 to 0.1 volt lower than the reactanceless electrostatic instrument gives.

The other transfer instrument referred to is a Kelvin multicellular electrostatic voltmeter of the vertical scale type, of 60 to 140-volt range, fitted specially with a mirror attached to the moving part so that deflections can be read with the aid of a telescope and scale, or of a lamp and scale.

The torsion-head of the instrument is adjusted so that its indications come on the scale at the voltage to be measured, and deflections on direct-current are obtained. The leads to the electrostatic instrument must be reversed in this test, and the mean of the direct and reversed deflections taken. This is on account of a small contact electromotive force existing in the instrument itself.

The alternating-current pressure is then applied and the deflection is again noted. To evaluate in volts the difference between the alternating-current and direct-current pressures, as measured in scale divisions, a near-by direct-current voltage is measured, and the number of scale divisions per volt is determined. The value of this quantity will vary somewhat with the angle of deflections, but in all cases it is sufficiently large. In the instrument referred to a deflection of about six centimetres per volt, at 116 volts, with the scale about one metre distant, is obtained. One-tenth of a volt corresponds then to six small scale divisions.

By adjusting the torsion-head of the

instrument it may be used for checking voltages in the fifty-volt range, or in the 220-volt range. By using a volt-box multiplier the range may be extended upward almost indefinitely. The sensitiveness of the instrument at a given angle of deflection is proportional to the voltage.

A check can easily be made in this way to 0.1 volt on steady pressures. With unsteady pressures a good comparison is much more difficult to obtain since the Kelvin instrument is very sluggish in its movements, due to oil damping, and to the very small moving force. For rough checks, such as alone are necessary when the pressure is unsteady, the telescope and scale may be dispensed with and comparisons made by reading the pointer of the instrument directly.

This type of transfer instrument has the very great advantage of being entirely free from reactance.

ALTERNATING-CURRENT AMMETERS.

For the calibration of alternating-current ammeters not belonging to the type, such as the Kelvin balance, the Siemens electrodynamometer, hot-wire instruments, etc., which are themselves reliable direct-current, alternating-current transfer instruments, the series of ampere lamps used with an alternating-current voltmeter, calibrated at one point as indicated above, serve admirably well. Practically all that has been said about these lamps in connection with direct-current work applies equally well to them used on alternating-current.

WATTMETERS.

Having voltmeters and ammeters calibrated by the methods indicated above, the calibration of direct-current wattmeters and of alternating-current wattmeters on power-factor unity can be made from them. Incandescent lamps standardized for watts instead of for amperes are useful in wattmeter calibration, rendering the use of a calibrated ammeter unnecessary. A set of lamps can serve both as ampere standards and as watt standards.

Mining Engineering and Metallurgy in the Massachusetts Institute of Technology.

A catalogue of the course offered in mining engineering and metallurgy at the Massachusetts Institute of Technology has been issued. This shows that the course has been planned carefully, and that the laboratories are excellently equipped. Two options are offered, one bearing more upon the mechanical engineering side, the other on surveying and geology. A course in field work is offered in the summer school, and occupies the month of June. Provision is also made for graduate study in mechanical and electrical engineering, surveying, chemical, or metallurgical lines of work.

THE TRACK CONSTRUCTION OF SUBURBAN AND INTERURBAN ELECTRIC RAILWAYS.*

BY S. S. HOFF.

The above subject is one of deep interest to the investor, the manager, the manufacturer, the local civic authority and the urban as well as the suburban populace, and in this opening decade of the twentieth century will more likely tend to develop more territory and civilize, in the higher sense, more people than any three decades of the past life of the steam railway; hence the importance of the development of the electric railway on true and correct lines can not be overestimated.

We have two systems of suburban and interurban electric railways now in operation by virtue of our street railway laws, the one constructed upon the public highway and the other generally under a steam railway charter through private property; each has its advantages and disadvantages, the adoption of either depending largely upon local conditions.

In locating and building a railroad, be it "steam" or "electric," it is not only the engineer's province to give the investor the best for the least money, but he must also think of the manager and consider fully the safety and economy of operation and maintenance.

In the public highway system the engineer starts out to build a railway under the supervision of not only his own employer and the local civic authorities, but also of every resident along its route, and in a short time he runs up against a mass of grievances in number almost as great as the number of residents.

Under the beneficent "rights" vouchsafed us by the charity of the steam railway managers, if your engineer is not a successful diplomat he finds himself trying to build a sectional railway, differing radically in many parts from his original well-thought-out plans, or else he encounters the broken link in his system with exasperating delays in the courts or in attempts to effect compromise before he secures a completed roadway; but we had better start to build our road and leave these generalities to the manager.

A preliminary survey of the highway is necessary to get a proper conception of the grades and alignment, and in projecting a location on this information it is frequently advisable to make many minor changes in the original roadway in order to avoid many small "kinks" in surface and line, and by judicious management with the local authorities this can be frequently accomplished; these changes may slightly increase the first cost of construction but are justifiable.

In the construction of a railway through private property much more judgment is required of an engineer than is necessary in building one upon the fixed line of a public highway, and more time should be accorded him in making a location than is generally given, principally for the reason that after the rights of way have been secured it is very difficult to make such revisions as subsequent developments may require or make desirable.

In securing rights of way, care should be taken that a width is adopted which will not only protect your road-bed, but also afford sufficient material for future repairs.

In the selection of a general route by the projectors of a road is where the engineer often encounters his greatest drawback to making a good location. The practice of the investor, as a rule, is to seek the poorest land on a farm for his railroad, at the sacrifice of his road-bed, under the impression that it cheapens the cost of the right of way, whereas my experience has been that the land occupied by a railroad is, in the eyes of the average farmer, "the best on the farm," his price being fixed on this basis, and very often where money may be saved on land damages it entails much additional cost in the construction and future operation and maintenance of the road.

In making a location it is advisable to keep away from bottom lands in the vicinity of long tortuous water courses and territory of rapid watersheds, as in such localities you find that it is necessary to erect many bridges, that material for embankments is very scarce and that the road-bed, especially light embankments, will be in constant danger of wash from high water and sudden downpours of rain forming rapid and uncontrollable floods.

Another thing to be avoided, wherever practicable, is a sharp curve in or at the foot of a heavy descending grade. This combination is the fruitful source of many accidents, as is so frequently attested by newspaper accounts of accidents caused by runaway cars.

Long straight lines or tangents are with many the great desideratum, and frequently to gain this end sharp curves are resorted to, whereas, by the introduction of some additional lighter ones, those with very short radii might often be avoided, and when the factor of safety together

*Paper read before the Pennsylvania Street Railway Association at York, Pa., September 10, 1902.

with the wear and tear of road-bed and rolling stock are considered relative economy results. The same rule applies to heavy grades, which should be avoided wherever practicable. It is much better to spend a little more money once to make the cuts a few feet deeper and the banks a few feet higher than to be constantly spending it for additional power to climb excessive grades; in general, simply because electric cars can be operated around sharper curves and over heavier grades than steam cars does not imply that these are desirable things to have in an electric railway.

In constructing the road-bed the cuts should be made wide enough, say, a minimum of fifteen feet, to admit of a ditch along either side of the track to keep the water from the ends of the ties.

The embankments should be of sufficient width to support the ballast under the ties and leave room beyond, on either side, for examining or "jacking up" a car should the running gear or machinery become disabled while running on the same; a minimum width of thirteen feet should be maintained upon all embankments. The slopes of both cuts and embankments should be made sufficiently flat to resist the erosive effects of the elements.

Should it be necessary to construct an embankment through marshy ground that can not be drained it will pay to make it of stone, if available, but if this can not be had, the next best plan is to cover the ground to the full width of the embankment, including the slopes, with a thick mattress of brush and build the embankment upon it; this will force the water out of the ground and secure a firm foundation.

In bridge work the masonry should be put up in a substantial manner, not necessarily of expensive cut work, but with an eye to solidity. Especial care should be taken to make the foundations broad enough to sustain the load to be carried, and deep enough to resist the action of frost and of abrasion or undermining by the periodical visitations of continuous high water and sudden floods. Should quicksand be encountered in foundations, it is best to bridge the same with a cement concrete floor, in fact I prefer making all foundations of concrete, giving ample time for the cement to set and harden before building upon it. In the point of durability stone or concrete arches, steel or iron superstructure, and wooden construction rank in the order named, the use of either depending largely upon local conditions and the amount of available funds.

Cast-iron pipe drains can often be used to advantage and with economy, but when you have decided upon the size of pipe to use at any point, do not fail to put one in of double its capacity, and under no circumstances use any of less than twelve inches diameter.

A thorough system of drainage should be adopted for all road-beds, not one which will concentrate the water upon your right of way and carry it along for an indefinite distance, as is often done in borrowing material for embankments out of ditches along and against its sides, but such a system as will provide ample openings at frequent intervals to carry across, if necessary, and away from the road-bed, all water wherever intercepted before it accumulates into large destructive volumes. All road-beds should be so constructed as to admit of placing six inches of clean gravel or broken stone ballast under the ties for the promotion of subdrainage and tamping the ties to a firm and elastic bearing, from the ends to about ten or twelve inches inside the rail bearings, the middle of the tie remaining untamped.

The ties should be placed two feet apart between centres; they should have a top and bottom face of eight inches, a depth or thickness of six inches and be not less than seven, preferably eight, feet long. They should be made of sound white or rock oak timber, if it is available, on account of its wearing qualities and its tenacity in holding spikes, but other woods such as white chestnut or spruce pine, if seasoned, must be substituted when the white oak can not be obtained.

The rails should be of a weight corresponding to the weight of rolling stock and service required, but no mistake has ever been made in using a too heavy rail. The weight of new rolling stock, according to present practice, never lessens after a road has been put in operation, and it is very difficult to keep a track in even fair surface or line when the rails begin to depress between the tie bearings.

The joints of rails should be made as strong as possible, splice plates, called "the continuous rail joint," giving the most rigid construction. The joints proper, or the ends of the rails, should come between ties with good tie bearings under the ends of the splice plates.

The rails should be laid with broken and not even or opposite joints to prevent the double hammer on the joint ties which the latter method produces, and which, in time, gives a slight downward bend to the end of each rail that can never be removed, hence rough riding.

I know engineers and managers frequently disagree upon the policy of "even" or "broken" joints, but I am willing to take my own experience with steam road work and that of old track repairmen to back up my position on this point whether a T or girder rail is used. "Special work" should be the best obtainable, long radii being always used on the switch ends in preference to the quick, jerky, short leads and points one often sees, and the best efforts should be put forth in securing dry and uniformly firm beds throughout the full length of the frog and switch-pieces to eliminate as much as possible the tendency to wear out in spots.

In order to maintain the proper gauge in the girder-rail construction the rails should be braced at about every fourth tie with the outside "pressed steel braces," the reason for my preferring this kind being that the weight of the car on the rail assists the brace in doing its work, there is no obstruction in the track to interfere with paving, and there are no screw threads to rust out or nuts to become loosened as with the tie rod.

Concealed joint-bonding I consider the best for a track and the least liable to be loosened by vibration or careless interference by trackmen at their ordinary repair work as well as affording protection against robbery, yet the utmost care should be exercised to secure a clean and full contact in the barrel of the hole in the rail, and such bond should be selected as would best produce this result. Riveting or bolting against the face of the web will retain contact about as long as it takes to attach the bond, for vibration will very soon cause the harder metal to compress the softer and thereby destroy the contact. Cross-bonding and bonding around special work should be as carefully done as the joint-bonding, using well-tinned copper for the purpose, and the lines of wire should be carried down and buried in the sub-grade to protect them against the midnight prowler and careless repairmen; but this work belongs rather to the electrical than the civil engineer.

At road crossings, excepting those with long skews, I would dispense with the use of wood or plank, substituting a length of rail on the inside of each running rail to form a groove for the wheel flange and packing the space inside and outside the track with broken stone covered with

screenings or, if this can not be obtained, with gravel and sand.

On all curves of less than 500 feet radius, I would recommend for safety the use in T-rail work of a guard rail along the inner running rail and bolted to it in like manner to the guard rail of a spring frog; this will give the assistance of the weight of the car on the running rail to hold the guard in place instead of depending entirely on spikes for that purpose; grooved rails should be used in girder work under similar conditions.

The outer rail of curves should be given sufficient elevation to overcome the centrifugal force generated by the highest rate of speed which the cars are capable of developing, in order to protect the passengers as well as the company against the careless or indifferent motorman who tries to make up lost time without consideration for possible consequences, yet there may be unavoidable parts of the road-bed where "slowing up" is essential to good running, and managers should never be lenient with discipline in dealing with a motorman who disregards instructions covering such points.

After the track is laid, tamped and surfaced, the space between the ties, to the top of the same, should be filled with broken stone, gravel or sand, materials which retain the least moisture, to hold the track in rigid position and prevent the shifting about which always results when this space is left open.

For safety, all private rights of way through pasture lands should be fenced, and cattle guards should be placed at all road crossings, even though they are not absolutely effective, in order to reduce to a minimum the danger from roving cattle, particularly on high-speed roads.

The proper section of rail to use where no paving is done is unquestionably the "T," but in cities and towns where much wagon travel parallel to the track is encountered and where special work is necessary in a wagon road, it is essential to use the "girder," and this should be deep enough to dispense with the use of chairs wherever possible.

All tracks in cities should be paved inside and outside the rails to the limits of the ties, and this paving should consist of a material and be so shaped as to shed water as rapidly as possible to prevent it seeping through to the ties.

To ensure this result it is best to cover the bed and ties with a cement concrete base, tamped in well against the web of the rails, which will not only keep moisture from the ties, but also, by giving a uniform and firm foundation to the paving surface, materially prolong the life of the whole roadway. If good material and workmanship have been put into the track and it has been properly ballasted, the most improved and lasting pavement is, with time consideration, the most economical to lay.

With the "right of eminent domain" accorded the steam road charter, which should also be extended at least to the interurban electric road, it is possible to build an electric road capable of being operated safely and successfully at any rate of speed to which the electric system of the future may be developed.

CURVES SHOWING THE AVAILABLE CAPACITY OF A LEAD ACCUMULATOR.*

BY ERNEST LUNN.

It is often necessary in operating central station storage batteries to tell on short notice how long a certain rate of discharge can be carried on the battery. If the battery be fully charged, this information can be quite readily had by consulting a curve made up from data depending on the capacity at various rates of discharge. This curve is commonly spoken of as the capacity curve. In laying out the plot the ordinates are arranged as rates of discharge in amperes. The abscissæ are the times in hours. The theory upon which the curve is based is that the available capacity of a lead accumulator increases as the rate of discharge decreases. It is assumed that the capacity at the one-hour rate is 5,000 ampere-hours, that for the three-hour rate 7,500 hours, and for the eight-hour rate 10,000 hours. The rates of discharge for the one, three and eight-hour rates are, respectively, 5,000, 2,500 and 1,250 amperes. The curve has the appearance of an equilateral hyperbola, but it is not, for the product of the two dimensions for any point is not constant, as it should be in hyperbolas of this form. By referring to such a curve it can readily be told how long any given rate can be maintained on the battery, provided it has not been previously discharged. For example, 2,500 amperes can be carried for three hours, as shown by the length of the 2,500-ampere rate line from the vertical axis to its intersection with the curve. In order to effect a simple calculation for a battery which has been partially discharged a set of curves is superposed on the capacity curve. These secondary curves are completed in the same manner to the capacity curve, the coordinates of the points making up the curves representing the same functions. They differ from the capacity curve in that they are equilateral hyperbolas, the produce for the two dimensions on any curve being constant. It is this difference in the curves that makes the combination of value. By making use of the secondary curves, any discharge which may have been taken out at a constant rate or at various rates of discharge can be readily reduced to the rate at which it is desired to discharge. As an example, it is supposed that 5,000 ampere-hours have been discharged from the battery in various discharges, and it is desired to know how long a certain rate—say, 4,000 amperes—can be carried on the battery. The 5,000-ampere discharge curve is followed until it intersects the 4,000-ampere rate line. The distance between this point of intersection and the point where the 4,000-ampere rate line cuts the capacity curve is the length of time that 4,000 amperes can be carried, which will be found to be fifteen minutes. With the battery in the same condition, 2,500 amperes can be carried for one hour, as shown by the distance between the points of intersection of the 2,500-ampere rate line with the 5,000-ampere discharge curve and capacity curve. It is not customary to work a battery near enough to its limit to make it necessary to consult such curves. It is, however, valuable in emergency cases to know how long a certain rate can be carried. Curves formed under these suggestions have repeatedly been found to be very reliable, and it is a source of no small satisfaction to the operator to know just how long the battery or batteries can be depended on to carry a given load when necessity so demands.

* Abstract of a paper read before the Association of Edison Illuminating Companies, Mount Washington, N. H., September 9, 1902.

Journal of the British Institution of Electrical Engineers.

The *Journal* of the British Institution of Electrical Engineers for August has been issued. This number, which includes the index, completes Volume No. 31, and there will be no further issues of this journal until the end of the year.

The papers contained in this number are the following: "Starting Resistances," by Mr. A. E. Gott; "The Equipment of a Modern Telephone Exchange," by Mr. F. A. S. Wurmull; "The Construction of High-Tension Central Station Switch Gears, with a Comparison of British and Foreign Makes," by Mr. H. W. Clothier; "Lighting and Driving of Textile Mills by Electricity," by Mr. M. Osborne; "Notes on Testing of Tramway Motors, and Investigation into Their Characteristic Properties," by Mr. M. B. Field. There is also a report of the deputation to the Board of Trade on the subject of "Legislative Restraints on Electrical Enterprises." The above papers and their discussions form an exceedingly valuable number.

The list of officers and members has also been issued. This shows that the society has attained a very satisfactory condition. There are, not including students, over 3,800 members.

Second General Meeting of the American Electrochemical Society.

The Papers and Proceedings of the Last Three Days at Niagara Falls, N. Y., September 16, 17, 18, 1902.

THE meeting on the second day, September 16, 1902, was called to order by President Richards at 10 A. M. in the auditorium of the Natural Food Company's building.

The first paper, by Mr. M. Ruthenberg, of Philadelphia, on "Developments in Electrometallurgy of Iron and Steel," was, in the absence of the author, read by Dr. E. Hart. This spoke of the occurrence of the various magnetic ores, their purity and the impurities present, which made separation and concentration necessary. Phosphorus and sulphur caused most trouble, as these were in combination with the iron. By grinding finely in water and then drying, the separation can be effected. Dry grinding may cause adhesion and therefore is not successful. Fine grinding gives a product unsuitable for the blast furnace, as it sifts down to the bottom leaving the coke behind. The open-hearth process employed melts the outside of the mass, leaving the inside unreduced. These faults have been overcome by forming briquettes, using various binders, all of which are fairly satisfactory. These ores have been treated successfully in this way. The pulverized ore is passed between the poles of the magnetic separator, these poles also forming the electrodes of the furnace. The magnetic ore adheres to the poles until it is almost molten, when it becomes non-magnetic and falls into a proper receptacle. The ore is merely fritted and is not reduced, further treatment being necessary in the blast furnace. Or concentration may be made to take place and the product treated in an open-hearth furnace at once, thus eliminating the blast furnace. Lime is not necessary and any grade of coal may be used, since this does not come in contact with the ore. This process of fritting has been carried out with an expenditure of energy of less than 500 kilowatt-hours per ton of ore, as against the figures of 3,000 to 3,500, as have been given for other electric furnaces for reducing iron.

In the discussion following this paper, Dr. Hart raised the question whether the separation was not electric rather than magnetic and spoke of Blake's process, which was tried in Denver. This consists in charging statically the particles of ore. Some of these assume a charge more quickly and discharge more slowly than others and this fact is made use of to cause the separation. The ore must be very fine and dry. He thought the author took too sanguine a view. The blast furnace is really the most economical of all furnaces. The question was simply one of shipping either the ore or the coal.

Dr. N. S. Keith thought the cost of energy would be prohibitive and that certain ores contained impurities which might go over and contaminate the product. Roasting would eliminate this. He doubted the economic application of this process.

Mr. W. McA. Johnson held that the cost of mining the lean ores would be greater per ton of concentrate and that therefore success would be assured only when the quality of the product was so much better, either physically or chemically or both, as to make up for this difference.

Mr. C. Hering questioned the economy of the blast furnace. Certain plants in Europe were getting enough from the sale of the gases given off to pay for making the pig iron.

Mr. Johnson stated that the economy of the furnace was obtained by using the gases given off to heat the air for the blast.

Dr. N. S. Keith called attention to Mr. Edison's work. The ore treated was only twenty to twenty-five per cent magnetic. The process consisted in separating magnetically, briquetting and reducing in the blast furnace. The cost per ton was sixty cents too high, but the process might become valuable if the richer ores become scarce.

Mr. C. J. Reed stated that Edison had a very difficult problem. The ore was contained in a hard granite. Phosphorus was present and hence it was necessary to grind finely. Acid treatment had been tried, but it was necessary to dry the ore before it could be separated and hence the method was abandoned. There is a constant demand for magnetic ore in this country and an economic method of separation would be valuable.

Mr. P. G. Salom thought that the possibilities of the electric furnace were not to be ignored. The blast furnace uses approximately seven times as much coal as theoretically required and this would seem to offer an opening for some new method.

President Richards stated that the figure given for the energy required in this furnace indicated an energy efficiency of eighty-three per cent. The cost of this power at Niagara would be $2.60 per ton of ore treated. This would be in addition to the cost of concentration.

The second paper was by Mr. R. S. Hutton on the "Fusion of Quartz in the Electric Furnace." After calling attention to the properties of quartz which made it valuable for physical instruments, the type of furnace which had been found suitable for this work was described. This is very simple, consisting merely of a graphite block upon which rest two smaller blocks carrying a thin carbon rod which forms the core of the mould. Larger rods form the sides of the mould. The quartz particles are laid in this and then placed under an arc. They become plastic and flow around the central rod, forming a tube. The central rod is easily removed after cooling. Long arcs must be used to prevent decomposition of the quartz. He used 300 to 500 amperes at fifty volts. The author had also been able to fuse quartz in graphite, forming crude lenses. Long treatment and high temperatures, he thought, would enable much clearer products to be obtained.

The third paper was by Mr. E. A. Byrnes on "Voltaic Cells with Fused Electrolyte," and described a long series of experiments for the determination of the electromotive force due to various electrodes in fused electrolytes.

Mr. Carl Hering read the fourth paper of the morning, on "An Apparent Electrochemical Paradox."

He described a curious experiment which he and Mr. Reed made some years ago in which water was decomposed in visible quantities at voltages far below the theoretical (about 1.45), even as low as about 0.3 volt. The experiment consisted in electrolyzing acidulated water in a strong U-shaped glass tube which was sealed at both ends and provided with a band containing mercury which enabled the mechanical pressures to be read off. The voltage at the terminals, when a constant current passed, diminished rapidly

and very decidedly to about 0.3 volt at about sixteen atmospheres, and then remained practically constant. Allowing for the loss due to resistance, the actual voltage of decomposition was even much lower—nearly zero. There was visible gassing during the whole test showing that water was really being decomposed; the increasing pressures also showed this. A possible explanation is suggested, based on the assumption that some of the gases probably passed mechanically to the opposite electrodes, which they could easily do in suspension, as the electrodes were very close together. These were consumed as depolarizers, so that only a fraction of the theoretical amount of gas was liberated. This depolarization lowered the voltage.

In the discussion which followed attention was called to the effects of pressure upon the solution, and the explanation suggested by the author was generally accepted.

The last paper of the morning was by Professor H. S. Carhart, on "The Nickel Concentration Cell." The electromotive force of this cell is just the reverse of the usual type of concentration. The action is wholly thermal and the effect of temperature upon its behavior was discussed.

The afternoon was devoted to visits to the Atmospheric Products Company's plant, where Dr. Bradley and his assistants showed in operation the apparatus for making nitrate and explained the process.

The Hydraulic Power Company's plant was also visited, and a trip through the Niagara Gorge was made in the evening.

The meeting Wednesday morning, September 17, was held at the International Hotel. Professor Goldsborough addressed the society upon the aims of the Louisiana Purchase Exposition, which is to be the largest ever held. Electricity will be much in evidence, and they are now trying to secure exhibits of electrochemical processes. He urged the society to aid in every way possible to secure a good showing in this department.

Professor Goldsborough said, in part, as follows:

At St. Louis, there is in process of development an international exposition in which this society can but be deeply interested. It will be brought to completion and presented for the education of the people of our country and the world at large, just at the time when the electrochemical industries of America will be acquiring that strength which will make them a most important element in our national life. Already I have heard it said by more than one distinguished foreigner that America is regarded as having gained an unimpeachable position and prominence in the building up of this new industry, and I can not but think our society hears these admissions with no small degree of pride and satisfaction.

To my mind, it is right and highly desirable that an intimate knowledge of conditions should exist between the electrochemists and the officers of the exposition. By the officers of the exposition I am commissioned not only to extend to you a hearty invitation to participate in their undertaking, but to go further, and assure you that in a most helpful spirit, they extend to you assurances of their great desire to place the resources of the exposition at your command to the end of picturing, in a way that will attract international attention, the true worth and vigor of this infant industry.

In the department of electricity one of its five groups is entirely devoted to electrochemistry.

Class 434 of this group is devoted to primary batteries and storage batteries. In this class, in addition to an exhibit of the finished product, efficiency tests of batteries will be inaugurated and a careful record kept of their performance during the period of the exposition. In addition to these, processes in the manufacture of various types of storage batteries will, it is hoped, be arranged for, in order that this matter may be pictured in a broad way.

Class 435 embraces electrolytic appliances and processes. All forms of electroplating, methods of electrotyping, and, finally and most important, the application of electrolysis in the reduction of ores and other related work, find place here; that this class presents the possibility of a most interesting and instructive series of exhibits will be at once recognized. Electrolysis plays an even greater and more important part in the business of the world each year. It has attained to a well recognized position. Yet, with increasing emphasis, the work we see about us here at Niagara Falls demands for it an ever broader and more important recognition.

Class 436 deals with electrothermic appliances and therefore includes all of the electric furnace applications which we have found pictured in the great local factories on such a large scale. Nothing is more impressive than an inspection of the actual work of the electric furnace. We are in fact almost appalled in noting the wonderful results, both in magnitude and industrial importance, which are brought about by the dissipation of electric energy by these means, and its transformation into heat. The electric arc, when applied on a large scale, attracts and rivets the attention not only of the initiated, but the uninitiated as well. It presents the picture of power in a most fascinating way.

Class 437 deals with the application of electricity to industrial chemistry; bleaching powder, disinfection of sewerage water, manufacture of soda, chlorine, chloride of potash, etc. Much can be done to make the exhibits in this class of great value and interest, not only to students, but to engineers and chemists. Some of the most interesting electrochemical operations find expression in the field of industrial chemistry, and a strenuous effort will be made to show all of its important divisions.

With the brief outline that I have given you, you will begin to appreciate the immensity of the task which is set for those servants of the exposition who will bring to its full realization the hope which I entertain for the success of the electrochemical group. That all the help and assistance which you, as electrochemists, can offer us will be most acceptable and gratefully received it is hardly necessary for me to say.

At the present time the success of the exhibits in the electricity department can be said to be assured, inasmuch as a large number of most interesting working exhibits have already been arranged for in the allied branches. A maximum load of 2,000 horse-power will be available for the development for working exhibits, and without doubt the building will teem with light and activity.

In closing I wish to say that the chief of the department of mines-metallurgy has extended to you through me the most cordial assurances of the interest which he takes in this work. It is his desire that in all its details the applications of electricity to metallurgy shall be given the fullest expression.

The following resolution was then offered by Mr. Hering and adopted:

WHEREAS, The American Electrochemical Society, in convention assembled, recognizes the great international importance of the Louisiana Purchase Exposition and feels that it will do much in placing before the people of the world a true picture of our national importance, and

WHEREAS, In no branch of our scientific or industrial progress have greater developments taken place recently than in the field of electrochemistry.

Resolved, That the American Electrochemical Society hears with great satisfaction the announcement that steps are being taken looking to the organization of a fine and comprehensive exhibit in the group of electrochemistry and offers assurances of hearty good will and cooperation in the accomplishment of this much to be desired end.

The second paper, by Professor H. T. Barnes, described in detail two types of accurate calorimeters which he has developed and tested thoroughly and found suitable for laboratory use.

The third paper of the morning was by Mr. A. Reuterdahl, on "The Electronic Hypothesis and Its Applications."

The fourth paper was by Mr. W. McA. Johnson, on "The Electrolytic Dissolution of Soluble Metallic Anodes," and de-

scribed some of the author's experiences in this work.

The last paper of the morning was by Mr. H. Rodman, on "Storage Battery Invention." The author stated the conditions which a practical cell must meet, an important one being the ability to stand overcharging, which would always occur in certain cells of every set due to non-uniformity of the cells. Many combinations of metals had been tried, but as yet only two gave practical results, the lead-sulphuric acid cell and the nickel-alkaline hydroxide cell. These two types were then compared and the faults of each pointed out. The nickel grid is stiff, but the oxides are non-conductors and not porous, as with the lead. Overcharging of the nickel cells causes loss of water which must be made good by adding distilled water. The electrolyte in this cell acts simply as a conductor, and a small quantity will therefore suffice if gassing can be prevented. In the lead cell sufficient acid must be present to affect the chemical change and conduct besides. The acid, however, enables the condition of charge to be determined. A disadvantage of the nickel cell is its low voltage, while the large capacity claimed for it has not yet been demonstrated.

The commercial life of a lead cell was given as from 15,000 to 5,000 miles, depending upon the type of cell and the service required of it.

In the discussion it was stated that carbonating was a serious trouble, as it increased the resistance of the cell. A layer of oil would prevent this, but oil was often objectionable.

The visit to Dufferin Islands, which was set for this afternoon, was abandoned on account of the condition of the grounds, and a special meeting was held to take up the papers necessarily postponed from the first two days.

The first of these was by Dr. F. Haber on "The Phenomena of the Formation of Metallic Dust from Cathodes." This was an exceedingly interesting account of the formation of clouds in the electrolyte under certain conditions. When lead or tin electrodes were used in caustic alkali and a heavy current passed, dense black clouds were formed. This was not the case if an acid solution was used. The author attributed this phenomenon to the formation of an alloy of the metal of the cathode with potassium, which, in the presence of water, immediately broke down and set free the combined lead or tin as a powder. Similar alloys, chemically prepared, gave the same effects when placed in water.

In the discussion several instances of somewhat similar phenomena were mentioned and attention was called to the remarkable effect of the cathode in certain electrolytic actions. A metal which could easily be deposited upon one cathode could be brought down only with difficulty upon others.

The second paper of the afternoon was read by Mr. A. H. Cowles on "A Unit of Quantity of Electricity for Use in Electrochemical Calculations." This suggested as a unit of quantity 500 amperes for one day, as this liberated one pound of hydrogen under standard conditions. One hundred amperes for one day liberated one cubic metre of this gas. The author then passed to some highly speculative consideration of certain coincidences found to occur when applying this unit in other ways.

The last paper of the afternoon was by Mr. E. R. Taylor on "Some Further Advances on the Closed and Continuous-Working Electric Furnace." The author described his latest type of furnace, in which the electrodes are formed of broken carbon fed in as necessary from each side, making the process entirely continuous. Drawings of this furnace were shown.

In the evening a banquet was given the society by the local members at the International Hotel. This was followed by a ball.

The convention met in regular session on Thursday morning, September 18, at the International Hotel, at ten o'clock.

The first paper, that of Mr. D. H. Browne, on "Lamps and Other Accessories in Electrolytic Plants," was read by Mr. W. McA. Johnson. This described somewhat in detail the author's experience with various types of mechanical pumps in this work. That found most satisfactory consisted of a simple pump, with ball valves, bedded in concrete. A satisfactory apparatus for evaporizing solutions was also described.

In the discussion, taken part in by Dr. Keith, Messrs. Hering and Johnson, attention was called to the use of air lifts in his work. President Richards spoke of the importance of the study of the mechanical appliances for electrolytic plants.

The second paper of the morning was by Dr. J. Langley, on "Electrochemical Polarization." This was read by Mr. Potter, and described a series of experiments to determine the electromotive force of polarization by the usual condenser and ballistic method. Experiments were carried out for various metals and electrolytes. The results were plotted in curves and showed an increase in the electromotive force of polarization with the applied voltage until a final value was reached. The author defined polarization as the electromotive force set up by the chemical change caused by the current.

In the discussion, taken part in by Messrs. Cowles, Hering, Potter and Richards, the various definitions of the term polarization were discussed.

The third paper, by Mr. C. J. Reed, was, due to the illness of the author, read by Mr. C. Hering. This discussed from the author's view-point the inconsistencies of the dissociation theory and described a rather elaborate experiment intended to show these clearly.

In the discussion of this paper, by Messrs. Johnson, Hering, Cowles and Potter, it was thought that all factors had been considered and that other effects, such as heating of the electrolyte, had not been sufficiently guarded against. President Richards gave his idea of dissociation. This was that there was no breaking up of the compound, though its physical form might change, but there was merely the substitution of an electric force to hold the atoms together for the "chemic" force which existed before solution took place.

After the close of this discussion Mr. A. von Isakovics offered the following resolution:

It be recommended to the board of directors that it was the sentiment of the society that the next meeting be held in New York city.

In seconding this resolution, Dr. N. S. Keith called attention to the fact that, except for Niagara, New York city offered the greatest opportunity to see electrochemical operations of any place in the world.

The resolution was adopted.

Mr. Carl Hering then moved that a resolution of thanks be extended to the local committee, the ladies' committee, the Natural Food Company, the Electrical Lead Reduction Company, the Carborundum Company, the International Graphite Company, the Niagara Falls Power Company, the Niagara Falls Hydraulic Company and the Atmospheric Products Company.

The resolution was passed and the secretary instructed to transmit it to the various companies when the convention had adjourned.

The next meeting of the society will be held in April, when election of officers will take place. All nominations must be sent in before the end of this year.

Book Reviews.

"Transactions of the American Institute of Electrical Engineers." New York. American Institute of Electrical Engineers. Cloth. 1,044 pages. 6 by 9 inches. Numerous illustrations and diagrams. Supplied by the ELECTRICAL REVIEW at $5.75.

This volume shows in its increased size, as well as in the character and number of the papers presented, the good work which has been accomplished by the Institute in the past year. Among the many excellent papers presented at the annual convention, August, 1901, two, at least, may be considered as classics. One of these was the paper by President Charles Proteus Steinmetz upon "Theoretical Investigation of Some Oscillations of Extremely High Potential in Alternating High-Potential Transmissions." The other was the paper by Mr. L. B. Stillwell, on "The Electric Transmission of Power from Niagara Falls." This paper, giving as it does an historical sketch of the developments at Niagara, contains practically the history of the development of electrical transmission during the last ten years. At the regular monthly meetings of the Institute, a number of important topics were discussed in papers presented by recognized authorities. These included very thorough studies of the problems involved in the distribution and conversion of electrical energy and in driving alternators by means of steam engines. The list of members shows a substantial increase, though not as great as could be desired.

"An Alternating-Current Calculating Device." F. G. Baum. Published by the author. Price, $1.00.

This device, which is accompanied by a twenty-two-page pamphlet explaining its use, consists of a sheet of cardboard, five and one-half inches by seven inches, whereon is drawn a series of arcs and cross-sectionings. Over this is placed a sheet of transparent celluloid marked with arcs, horizontal and radial lines. The two are joined by a fastener which permits the rotation of the upper sheet on the lower. By means of this arrangement the regulation of any alternating-current system may be determined by inspection for any power-factor or percentage of full load. The resistance and reactance of the line must be computed before the device can be used. The pamphlet gives tables and curves for assisting these computations. Altogether, it is a very helpful and labor-saving arrangement, and its use will save much time and mental effort in determining the regulation of transmission lines, transformers or other appliances in which resistance and reactance are present. We, however, can not help pointing out the slipshod character of the workmanship, both of the device and the pamphlet. The diagrams are rough and crude, and the lettering so poor as to be almost undecipherable in some instances. The fastener, about which the celluloid sheet rotates, is of the flimsiest kind and may be expected to pull loose after very little wear. It is lamentable that such an excellent device should have its usefulness marred by poor mechanical workmanship, and it is to be hoped that this serious fault will be remedied.

"Handbook of Electrical Machinery Apparatus of United States Seacoast Defences." George S. Anderson, A. M., Captain United States Artillery. Published by D. Van Nostrand. Size 9¼ by 5¾. 161 pages. 214 illustrations and diagrams. Price, $3.00.

This book was written primarily for the use of electricians in forts and on battleships, and treats clearly and comprehensively such subjects as are essential to the understanding of the work and apparatus employed in the army and navy. The book contains much that is of value to electricians and electrical workers in general—though it is too elementary to be of any assistance to the engineer. Boilers, engines, both steam and kerosene generators, motors, switchboards, the storage battery, searchlights, primary batteries, electrical signaling apparatus, telegraph and telephone apparatus, together with certain special devices, are all discussed, and rules for handling, operating and maintaining are given.

The work is admirably adapted for the instruction of a special class of electrical artisans, but is hardly to be recommended for general reading, unless the reader be interested in the applications of electricity in the situations mentioned.

The International Association of Municipal Electricians.

The seventh annual convention of the International Association of American Electricians, to be held in Richmond, Va., October 7, 8 and 9, from present indications is to be one of the most enjoyable and profitable meetings which the association has ever held. The meeting will be called to order in the assembly hall of Murphy's Hotel, on Tuesday, October 7. Addresses of welcome will be made by A. J. Montague, Governor of Virginia, and R. M. Taylor, Mayor of Richmond. At three o'clock of the same day the visiting ladies, accompanied by a committee of Richmond ladies, will be provided with carriages, and points of interest in the city will be visited. On Wednesday, October 8, at three o'clock in the afternoon, the entire delegation will be given a trip down historic James River on the steamer Louise. On this trip dinner will be served on the boat. A fine programme has been arranged for the entertainment of the delegates. On the afternoon of Thursday, October 9, the delegation will be given a ride through the principal streets of the city to Lakeside Park, where luncheon will be served.

Among the courtesies to be extended to the members of the association is the free use of the American Bell Telephone and Telegraph Company's lines from 9 A. M. to 6 P. M., on October 7, 8 and 9, all conversations being held at the company's office in Richmond. Similar courtesies have been extended by the telegraph companies, all messages being countersignd by either Frank B. Foster, secretary of the association, or W. H. Thompson, chairman of the executive committee. Free transportation over all street car lines has been extended by the Virginia Passenger and Power Company. In accepting these privileges, special badges, which will be supplied in Richmond, must be worn.

Kansas Independent Telephone Association.

About 150 delegates from various parts of the state of Kansas, as well as from Missouri and other states, attended the convention of the Kansas Independent Telephone Association, held in Kansas City, Mo., on September 11 and 12. This meeting was held at the invitation of the Home Telephone Company, of Kansas City. Mayor Reed delivered an address of welcome to the visitors, and asked the cooperation of all the Kansas independent companies in promoting the interests of the new company. On adjournment, the association voted to hold its regular annual meeting in Topeka, Kan., during the month of January next. Among the exhibitors of telephone apparatus at the headquarters in Kansas City—the Coates House—were: The Sterling Electric Company, Stromberg-Carlson Telephone Manufacturing Company, Kellogg Switchboard and Supply Company, Central Telephone and Electric Company, of St. Louis, Illinois Electric Specialty Company, Swedish-American Telephone Company and Electric Appliance Company.

Interstate Telephone Convention.

At a meeting of the officers of the recently formed Interstate Telephone Association, held a short time ago in Chicago, it was decided to hold the next convention in Chicago on December 10, 11 and 12. The exact place of meeting will be determined by a committee of which Dr. I. A. Lumpkin, of Mattoon, Ill., and Charles E. Hull, of Salem, Ill., are members.

HIGH-TENSION WORK IN THE FAR WEST.*

BY GEORGE H. LUKES.

(*Concluded from page 371.*)

The cross-arms are made of selected kiln-dried Oregon pine six inches square and an overall length depending on the distance between wires. After passing through the dry-kiln they are placed in an enclosed boiler containing asphaltum oil and subjected to a temperature of 220 degrees Fahrenheit for several hours. This preserves the wood, and at the same time increases the insulation of the pole top. The arms are gained into the pole a distance of one inch and are held in position by two five-eighths-inch through bolts, with cast-iron washers three inches in diameter under both head and nut. The cross-arms are surfaced all round and crowned on top to shed the water. The insulator pins are of oak, locust or eucalyptus wood. The latter wood is universally used on the coast on account of its immunity from attack by worms and bugs, even the deadly toredo not touching it. The eucalyptus pins are treated in the following manner. The timber is sawed into sticks three inches square and placed in boiling water for twenty-four hours. After being air-dried for several months it is worked up into pins. The pins are then placed in a vat of boiled linseed oil and kept at a temperature of 210 degrees Fahrenheit for several hours. The pins are sixteen and seven-eighths inches long over all and the diameter of the lower shoulder is two and three-quarter inches. They are driven into the cross-arm with special care, a hard wood pin set being used. The pin holes in the arm are two and one-quarter inches in diameter and five inches deep, leaving one inch of solid wood below the pin. On each side of the pin, at a distance of three inches from the pin and two inches from the top of the cross-arm, one-half-inch carriage bolts are placed in order to prevent the arm from splitting when unusual strains are thrown on the pins.

One very noticeable feature of the pole-line construction is the absence of guy wires. On account of the high voltage, the ordinary strain insulator is of no use, and the common practice is to use wooden struts. These are of timber six inches square fastened to a dead man buried five feet in the ground and bolted through the pole at the cross-arm. Sometimes, when a guy can not be avoided, the strut is used as an anchor, or if a guy is used timber six inches square and twenty feet long is inserted in the guy as a strain insulator. The poles are usually set about 130 feet apart, and whenever a small angle is made in the line two poles are placed close together in order to divide the strain. On all angles double arms are used and double cap pieces bound with wrought-iron bands support the top wire. In single construction the pole pin is usually driven into the top of the pole and a wrought-iron band driven down on to the pole to keep it from splitting. In some cases a bracket pin three feet long and four inches square in section is bolted through the pole.

The line is staked out by a surveyor, the poles are set with a plumb-bob, and foreman of construction carries a thermometer and a set of curves, from which he fixes the proper sag to give to the wires. The wires are placed at the points of an equilateral triangle. The wires are from thirty-six to forty-two inches apart and are spiraled, one-third of a twist being made every mile.

The insulator in common use is of the two-part type, the upper petticoat being of porcelain and the lower part of glass cemented into the porcelain. The upper petticoat is nearly flat and is provided with a rim and spout to drain the water clear of the cross-arm. The lower petticoat is shaped like a truncated cone and protects the pin. This insulator measures eleven inches in diameter across the top petticoat and is eleven inches in height. When in position on the arm the wire is fifteen inches above the cross-arm. The general feeling among power transmission men is that no insulator in use at the present time would be safe to use on 60,000 volts. The large transmission companies intend to go up to 60,000 volts as soon as additional line capacity is needed, but as this means changing every insulator on their lines at an expense of several hundred dollars per mile they will delay action until they are reasonably sure that they have secured the proper insulator.

Aluminum wire has been used largely for transmission purposes on the coast with good results. Owing to the high coefficient of expansion of aluminum, care must be taken in stringing the wires to allow sag enough so that the wire will not be too taut in cold weather. A peculiarity of aluminum wire which makes its use in small sizes objectionable is its low melting point. Aluminum melts at 1,157 degrees Fahrenheit, copper at 1,929 degrees Fahrenheit, and wrought iron at about 2,800 degrees Fahrenheit. When an iron wire falls across an aluminum circuit and makes a short-circuit the aluminum wire is melted through and the iron wire remains intact. Thus the trouble is cleared from the circuit, but at the expense of opening the line.

That pole lines are not absolutely reliable, and, moreover, are expensive to maintain is shown by the fact that one company is seriously considering the plan of substituting a series of steel towers about ninety feet in height and 1,000 feet apart, the wires to be suspended from tower to tower and separated about nine feet. Although this construction will be more expensive than that of the ordinary pole line, it is thought that the decreased number of breakdowns and lower maintenance and depreciation charges would warrant the extra investment.

No large central station manager could afford to buy current even at a very low rate if the source of supply was not reliable. This situation led to the construction of duplicate transmission lines. At first two lines were installed on the same set of poles, but it was found that when trouble occurred on one line it was usually communicated to the other line, and so this practice has been abandoned and duplicate lines on separate pole lines are now considered necessary. Even with the introduction of duplicate pole lines the situation is not entirely satisfactory on account of the short shutdowns caused by the difficulties in switching high-tension lines. The switches in ordinary use are of the air-break type, and while it has been claimed time and again that they can be opened safely under load, yet the fact remains that it is dangerous to do so, both on account of the surges set up in the transmission line and the arc at the switch which is often disastrous. When one transmission line is held in reserve and trouble occurs on the line in use it takes some little time to switch in the good line. When the two lines are run in multiple and a short-circuit occurs the usual practice has been to either burn off the trouble or shut down the station and start up on the good line. If the short-circuit is serious and is burned off the disturbance in frequency and voltage is usually sufficient to cause all synchronous apparatus at the end of the line to drop out of step.

The problem of securing good regulation on long lines has been a very troublesome one. Some of the difficulties due to inductive loads and charging currents have been overcome by the proper use of induction and synchronous motors combined with reactance coils connected across the circuit, but the facts remain that a railway load on the end of a long transmission line is a bad thing as far as regulation is concerned, and the time will come when the transmission companies will be forced to refuse railway business unless storage batteries are installed to keep down the rapid fluctuations in load.

The transmission companies are wholesalers of electric current. They generate current, transmit it to the market and sell it in large quantities to the local companies, reserving the right, as a rule, to sell current directly to large power consumers. The usual method of charging is by the horse-power per year. The rate varies from $18 to $90 per horse-power per year.

The future of long-distance high-voltage transmission in the West depends largely upon the development of oil as a fuel. If the production of the oil fields continues to increase so that oil entirely displaces coal as a fuel in certain sections of the country, it is evident that the price of fuel will be so lowered that the transmission plant will be unable to compete with local plants using oil as fuel. On the other hand, in certain sections fuel will always be high on account of high cost of transportation. It is in these localities that the power transmission companies will find their best field for growth.

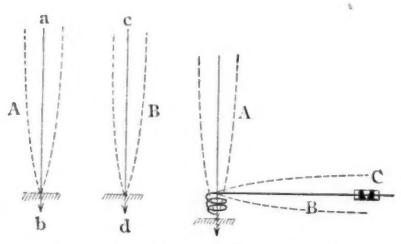
*Abstract of paper read before the Association of Edison Illuminating Companies, September 9, 1902.

Wireless Telegraphy by the Slaby-Arco System.

By A. Frederick Collins.

IN THE issue of the ELECTRICAL REVIEW of August 23 I described a system of wireless telegraphy invented by Professor F. Braun, of Strassburg, and in this article I propose to treat of an opposition system designed by Dr. A. Slaby and Count Arco, of Charlottenburg.

Interest is attached to both these sys-



FIGS. 1 AND 2.—REPRESENTING THE SENDING AND RECEIVING ANTENNÆ.

tems, especially in Germany, in view of the recent litigation involving some of the fundamental principles. By a comparison of the Braun and the Slaby-Arco systems it will at once be apparent that they differ materially, both in theory and in mechanical and electrical construction of the apparatus, though there is an inevitable strain of similarity traceable not only in these, but in all systems of wireless telegraphy.

In a lecture delivered before the Allgemeine Elektricitäts Gesselschaft, in Berlin, on December 22, 1900, Dr. Slaby described his theory of "Syntonized and Multiplex Spark Telegraphy," a short *résumé* of which will assist in elucidating the appended description of the apparatus.

Let A-B, Fig. 1, represent the sending and receiving wires or antennæ of a wireless telegraph system, and at a distance from each other; now, if high-frequency, high-potential currents are set up in the wire, *a b*, electric waves will be emitted in line perpendicular to the plane of the antenna and when these impinge on the wire, *c d*, at B counter and syntonic electric oscillations will be set up, the amplitude of which will follow a sine wave law between the free end and the ground, the greatest amplitude being at *a* and *c*, assuming each wire to be $\frac{\lambda}{1}$ in length (λ is the length of the emitted wave), and *b* and *d* constituting the nodal point of the electric oscillations.

The sending and receiving wires possess a certain electrostatic capacity and inductance and if a wave is received at B, the frequency of which is different from that which the sending wire is tuned to obtain resonance effects, the oscillations set up will not be in rhythm and the effects will be very feeble if not entirely *nil*.

In order to produce a syntonic system it is necessary that the receiving wire should have the same capacity, inductance and resistance as the sending wire and that both should be of a length one quarter of the wave-length emitted. Since the point of greatest amplitude of the

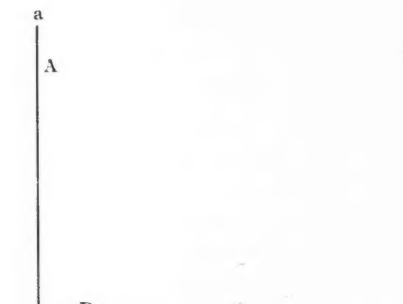


FIG. 3.—THE COMPLETE RECEIVING WIRE.

oscillation is at *a*, it is only logical to postulate that the coherer or other detector should be placed at this point in order that the maximum effect of a potential difference may be utilized, but as the free terminal of the receiving antenna is often thirty or forty metres above ground it would be impracticable to place the coherer at this elevation; to overcome this objectionable feature Slaby extends a second wire (Fig. 2), B, at right angles to the receiving wire, A, connecting one of its terminals to the nodal point or earthed terminal of the receiving wire, and the opposite terminal to the coherer, C; the amplitude of oscillation at C, then, is exactly that of the free end of the receiving wire, A. The action on the detector by means of this arrangement is to produce oscillation potentials of great amplitude, while the tension of the opposite conductor plug of the coherer remains constant by its connection with the earth, which acts as a very large capacity, producing a potential difference of the greatest maximum value.

To economize space the wire, B, may be coiled up, provided that care is taken to maintain the proper values of inductance and capacity between the wires, AB; the complete receiving wire system is shown diagrammatically in Fig. 3, in which A and B are the receiving wires as before, C the coherer, and D a coil formed by the wire, B, having a special winding, the object of which is also to increase the wave amplitude to larger dimensions than at the terminal, *a;* this is what Dr. Slaby terms a multiplier. E is a condenser having approximately a capacity 100 times that of the coherer; it is in series with the wire system and in parallel with the battery, F, and local indicating circuit, which includes the relay, G. By this arrangement false signals, caused by atmospheric variations of potential, are almost entirely eliminated, for the + and − charge at *a b* are equalized without producing oscillations in the receiving wave system. Another advantage of this

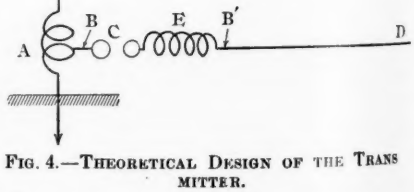


FIG. 4.—THEORETICAL DESIGN OF THE TRANSMITTER.

method, it is pointed out, is that of employing lightning rods for antennæ in places where the former are already in use, and a third feature is the increase of the received oscillations by the multiplying coil, D.

The oscillator system of the transmitter is similar to the receiver, consisting of an earthed antenna, although its function is

diametrically the opposite to the receiving system. In the oscillator the low-frequency, high-potential currents produced in the secondary coil by the interrupter is transformed into high-frequency, high-potential currents by means of the disruptive discharge through the spark-gap; electric waves are emitted and

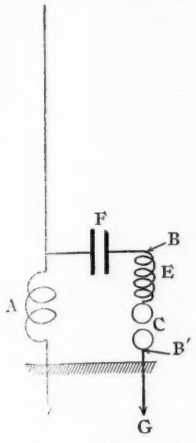


FIG. 5.—INSERTING A CONDENSER IN THE SYSTEM.

propagated through space to the receiver, which, being in tune, or syntony, with it, responds to the fundamental harmonic tones.

The transmitter is shown in its simplest theoretical form in Fig. 4. The coil, A, is an adjustable inductance which is employed to regulate the fundamental tone of the transmitter, and, as a natural sequence, the addition of this inductance decreases, within certain limits, the periodicity of oscillation, thereby lengthening the emitted wave; C is the spark-gap, which is connected to the secondary of the induction coil (not shown) by means of the leads, BB'; AD represents a hori-

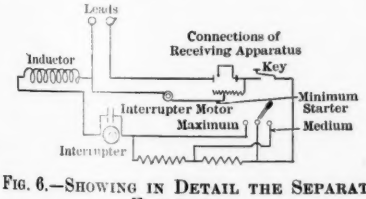


FIG. 6.—SHOWING IN DETAIL THE SEPARATE FUNCTIONS.

zontal wire equal in length to the antenna and is one-quarter the length of the emitted wave; the wave-length may be further increased or decreased by the inductance coil, E. The period or frequency of the oscillations must be in exact tune with the oscillator system so that the maximum effect will be obtained by the oscillations; namely, that the wave will have its greatest amplitude at the extreme end of the free antenna.

As in the receiver, the physical apparatus may be made to take up a very little space by inserting a condenser in the system, as indicated in Fig. 5 at F. Similar parts are lettered in accordance with Fig. 4. By inserting the condenser, F, and the coil, E, the capacity and inductance may be made equal to that of the antenna; by this means the inductive radiation of the horizontal wire, AD, Fig. 4, is eliminated.

The damping coefficient of this transmitter is much less than in the open oscillator type, such as were first employed in wireless telegraphy.

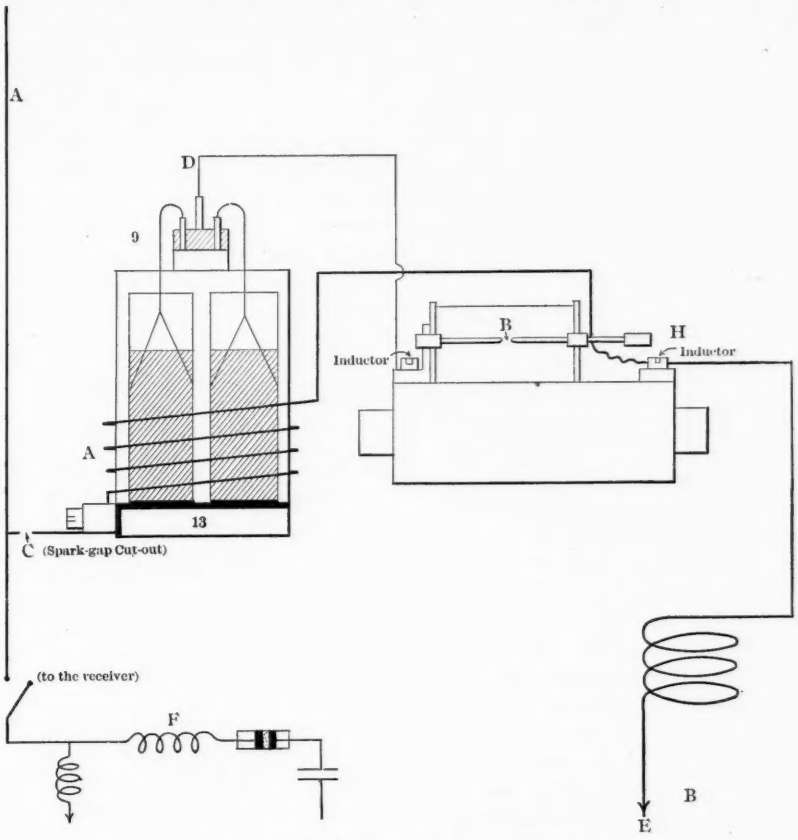


FIG. 7.—THE DIAGRAM OF THE OSCILLATOR SYSTEM.

That the diagram of the transmitter may not appear too complicated, the primary winding of the induction coil, with its accessories—*i. e.*, the primary condenser, the mercury turbine interrupter, with its motor and variable resistance; Morse register, with magnetic blow-out,

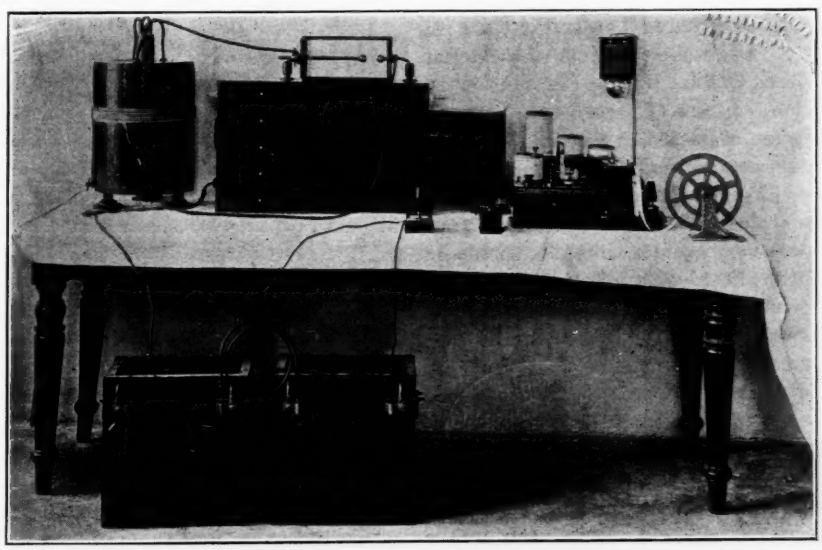


FIG. 8.—STORAGE BATTERY AND OPERATING APPARATUS.

and lightning arrester—is shown separate (see Fig. 6) from that of the oscillator system or high-tension circuit, Fig. 7.

The primary winding, or inductor, is wound in accordance with the distance to which messages are to be sent. For distances up to forty kilometres an induction coil giving a maximum spark of fifteen centimetres is used, the inductor of which is fed by a storage battery, shown in Fig. 8, having a potential of sixteen volts, the coil operating on fifty to one hundred volts. For distances up to eighty kilometres a thirty-centimetre spark-coil is required and having a maximum load of one kilovolt-ampere, which may be an alternating current from a Grisson transformer or a direct current made and broken by a turbine mercury interrupter. For greater distances the inductors have an output of three kilovolt-amperes.

The condenser is connected in parallel with the interrupter, whether of the turbine type or the Grisson direct-current alternating converter, which delivers a pure alternating current, the wave-form of which may be varied within wide limits. The Morse key is fitted with a magnetic blow-out, which will be appreciated by operators who have had trouble with fused contacts when working with heavy currents. The function of the lightning arrester needs no explanation.

The oscillator system, Fig. 7, includes the antenna, a battery of Leyden jars, spark-gap, cutout, the secondary winding of the induction coil, by which the oscillator is excited, and a storm emergency switch. The battery of Leyden jars, A, shown in the photograph to the extreme left, and in the diagram, Fig. 7, in cross-section, consists of three, seven or fourteen jars contained in a cylindrical cardboard case and protected by layers of felt. The jars are double, and each has a capacity of 0.001 microfarad. For transmitters having antennæ twenty metres in length, three double jars will suffice; for forty-metre sending wire, seven double jars are required and for vertical wires of greater length fourteen double jars are used. The spark-gap, B, is earthed at E, as shown in the diagram, thereby eliminating the dangerous physiological effects which might result if the body came in contact with the high-tension circuit.

The sending wire consists of one or more rubber insulated leads, and, in order to obtain a larger radiating surface, ten per cent of the total length is wound into the form of a cylindrical cage at the free end. The spark-gap cutout, C, is inserted between the sending wire and Leyden jars so that the connection between the oscillator, B, and the wire, D, may be automatically separated, while the receiver, F, is taking messages. It will be observed in both the photograph and the diagram that a few turns of wire are wound around the box containing the Leyden jars; this is termed the syntonizing coil. The storm emergency switch is placed between the antenna and the sending and receiving apparatus and is kept open in stormy weather.

The receiver, shown to the right in the

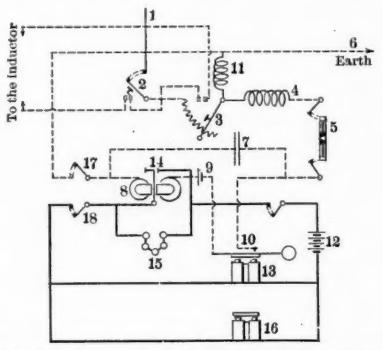


FIG. 9.—SHOWING THE CONNECTION AT THE RECEIVER.

photograph and schematically in Fig. 9, consists essentially of the electric wave system, the coherer and relay circuit, and the tapper and Morse register circuit. These two circuits will be easily traceable, since the weak current circuit is shown in dotted lines and the heavy current circuit is represented by continuous lines.

The receiving apparatus is connected

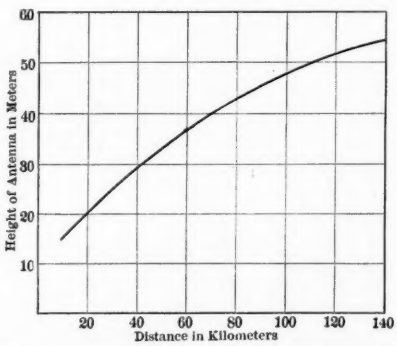


FIG. 10.—CURVE SHEET OF DISTANCE TO MAST HEIGHT.

with the antenna, 1, by means of the cutout, 2, as just described. Assuming 2 to be in contact with 1, the oscillations set up by the waves pass through 3, a regulating resistance, then through 4, an inductance coil, and finally impinge on the coherer, 5, the potential difference of which is maintained by the opposite terminal of the coherer leading to the earth, 6, with the condenser, 7, intervening.

The relay, 8, is operated by the coherer cell, 9, which leads through the interrupter, 10, to the coherer, the circuit being completed through the branch coil, 4, the earth coil, 11, and the return to the relay. The heavy current circuit includes the battery, 12, the tapper, 13, the relay working contact, 14 (which includes the tongue), the polarizing battery, 15, the elements of which are connected in parallel, the Morse register, 16, and the call bell connected in parallel to the Morse register, but not shown.

The Slaby-Arco coherer is of the vacuum type, protecting the filings from oxidization and keeping the filings perfectly dry and movable; this condition allows the filings to be similarly grouped after each stroke of the decohering hammer. The terminal conductor plugs are of silver, fitted to a nicety into the tube; the terminals are of heavy platinum wires with metal caps fastened to the ends of the coherer. The pocket joined by the conductor plugs is V-shaped, and by this arrangement varying degrees of sensitiveness and accuracy may be had, but the one always at the expense of the other. For instance, if the pocket holding the filings has its smallest part downward as a V, the filings fill up the greater part of the pocket, the pressure is increased and its sensitiveness is at its maximum; but if the pocket is inverted thus, ∧, the filings are spread over a larger surface, the pressure is reduced, the sensitiveness is at its minimum and its accuracy at its maximum. The coherer is arranged to be revolved round its axis to obtain this adjustment.

The interrupter spring, 10, is switched in by the movement of the decohering tapper just before the ball strikes the coherer, so that the relay and coherer circuit is opened and the tension of the cell 9 is removed from the coherer. The cell is merely a dry element, having a pressure of 1.2 to 1.5 volts; with higher voltages the accuracy of the coherer is destroyed, with less, the relay does not respond well.

The coherer resistance is, when reduced, about 2,000 ohms; the relay is wound to have normally the same resistance. The relay is of the Siemen's polarized type, and in operation a permanent steel magnet energizes two cores of the coils so that the pole-pieces have the same magnetic polarity. A tongue of soft iron is likewise magnetized by the permanent magnet, but to the opposite polarity since it is placed between the pole-pieces. Two contacts are provided, one a working contact and the other a stationary contact.

By varying the positions of these contacts the tongue is brought into a state of unstable magnetic equilibrium, so that when it rests against the stationary contact no current passes through the relay, but if a weak current passes through the coils the initial magnetism of one of the cores is increased and the other is weakened. In this way an exceedingly sensitive adjustment may be had.

Connected in parallel with the relay, 8, and the dry cell, 9, is the condenser, 7. Its capacity, compared with that of the coherer, is infinitely large. It is of the mica type, and its function is to take up any excess of potential which would otherwise be exerted on the coherer due to the inductance of the relay. The regulating resistance, 3, is inserted to decrease the effect of the received waves when telegraphing over short distances. The switches 17, 18, 19 open and close the weak current circuit, the heavy current circuit and the antenna and ground leads.

The distance curve, shown in Fig. 10, is the result of tests to determine with precision the exact height of antenna required to transmit messages over a given distance, and has been plotted with the utmost care. The curve represents the guaranteed maximum distance for telegraphing over the sea with the Slaby-Arco standard station sets of medium size. Wide latitude is allowed for climatic changes and unfavorable conditions of the year, such as disturbances due to the hot summer months. That the curve may be relied upon is shown from the fact that it was found possible to transmit messages between the Deutschland and Duhnen, a distance of 150 kilometres with antenna forty metres in height, whereas the curve gives the working distance as eighty kilometres or a little more than half the absolute distance.

Among the more important wireless telegraph installations the Allgemeine Elektricitäts Gesselschaft has made of the Slaby-Arco system may be cited that of equipping some forty vessels of the Imperial German Navy, including the Hohenzollern, the German Emperor's yacht; a number of ships of the Hamburg-American and North German Lloyd lines, besides supplying instruments to Austria, Sweden, Norway, Portugal and Chili for the marine service, to Russia for the postal telegraph service and to Denmark for connecting a lightship with a lighthouse a distance of thirty kilometres. A most interesting installation of the Slaby-Arco system is that in operation between Zagspitze, the highest mountain in Germany, and Eibsee, a station 2,000 metres below. Besides those noted, many minor installations are in operation doing routine service with as much accuracy as one would expect of a wire equipment.

THE DESIGNING OF TELEPHONE APPARATUS—III.

BY W. A. TAYLOR.

Fig. 3 represents a well-known type of transmitter, in which D is the diaphragm, A is the back electrode rigidly fast to the bridge, F; E is the front electrode which is attached to the diaphragm, C is the granular carbon and B is a band of felt, flannel or other fabric which is wrapped around the electrode in such a way that it retains the granular carbon. Now as long as the diaphragm has no tension upon it and there is no rubber gasket around the edge it may be possible to

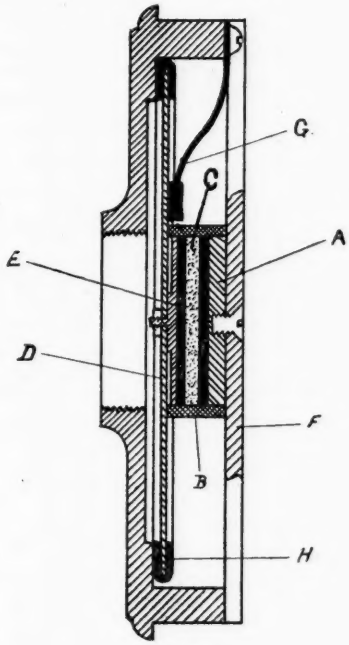


FIG. 3.

know the distance between electrodes. But suppose that the diaphragm is supported in place by the damping spring, G, and that it has a rubber gasket, H, about the edge. It will then be impossible to tell the distance between the electrodes. Another point is that in some of the instruments the felt, B, will press tightly against the diaphragm while in others it will not. This will tend to make a difference in the action of two instruments. In this type of instrument there is always a danger of the granular carbon getting away, especially if of very small size.

As another style let us take up the Bell long-distance or solid-back type. There are many of similar design, but this will serve as the type. Fig. 4 is a drawing showing the essential points of the instrument. It represents a very fine example of mechanical design, as when it is assembled its dimensions are all known. A is the diaphragm, B is the button or carbon receptacle, C is the bridge. It will be noticed that the front electrode is mounted upon a small diaphragm, D, which is of mica. This electrode is also fastened to the diaphragm, A. The back electrode is fastened to the bottom of the cup. From the rear of the bottom a shank extends through the bridge, C, where it is fastened by means of a set screw. The usual damping springs (not shown) are applied and the rubber gasket, F, is also present. In assembling, the gasket is placed around the diaphragm, then the button is fastened to the diaphragm and the whole is placed in position and the damping springs put on. The bridge is now slipped over the shank of the button, and the ends screwed down tightly. The contacts of the button are then shaken up so as to be sure that it is not packed and the set screw, G, is tightened. The electrodes, in this process, have not changed at all in their relation to each other, and in case at any future time the diaphragm gives somewhat so there is a tension on the mica the set screw is merely loosened and then tightened again.

The retaining-cup of the transmitter should present a neat appearance, as it is always in view. The outlines should be tasteful and as small as is consistent with the size of the apparatus which goes inside of it. The parts are usually a front and a back casing. This front, as is seen in Fig. 4, is better of cast metal. The back is usually a stamping. In any case the material should be strong and stiff enough so that it will not vibrate with the voice. Another point lies in the space between the diaphragm and the front. This spacing should be made small, as is shown in Fig. 4. If made large it makes the case most too large and also is apt to give rise to a disagreeable echo in the instrument. This spacing need not necessarily be more than three thirty-seconds of an inch. The mouthpiece need not be made large. A medium sized mouthpiece is much better than a large one. Here, again, a bad echo is made with the large mouthpiece. The small mouthpiece looks better and is better. It is a good idea to have a perforated guard in the bottom in order to protect the diaphragm.

Mention has been made of local battery transmitters and central energy transmitters. The whole difference between these two types of instrument lies in their resistance. In the local battery transmitter the normal resistance is in the neighborhood of fifteen ohms. The central energy instrument has a normal

resistance, in the best cases, of about seventy or eighty ohms. The variation in the resistance of the local battery transmitter runs from five ohms to thirty ohms, while in the central energy transmitter the resistance may vary from forty ohms to 300, according to the pitch and loudness of the voice waves. With the local battery transmitter the current supplied is usually only about three volts and the change in the current is very great, owing to the low voltage. In the above transmitter the greatest current would be one-third ampere and the least current is one-tenth ampere, a change of 0.233 ampere.

In the case of the central energy transmitter the variation must be great, as there has to be a considerable resistance on the line and in the switchboard circuits, so the resistance introduced must be a very appreciable portion of the circuit. For example, suppose a battery power of thirty volts supplies the system. There are 100 ohms resistance through which this current passes in going through the switchboard, and fifty ohms resistance in the line and induction coil. The whole resistance, exclusive of the transmitter, is then 150 ohms. With the minimum resistance of forty ohms in the transmitter the current flowing will be 30 ÷ 190 or 0.158 ampere, and at the higher resistance the current will be 30 ÷ 450 or 0.66, showing a current change of 0.092 ampere. It will be seen that a local battery instrument used in place of this instrument would have indicated a change of only 0.027.

Some authorities have stated that it is the great proportionate change in the current which produces the best results. This is a mistake. It is true only when the larger quantities of current are considered. For instance, if the normal flow of current was 0.05 ampere, and this flow varied when the transmitter was in use from 0.025 to 0.075 that would be a large proportionate change of 3 to 1, but a difference of only 0.05 ampere. It is the large difference between the maximum and minimum current which determines the talking qualities. In the case where induction coils are used it is the difference in the ampere-turns maximum and minimum which determines the transmission.

In making up a design for a transmitter, if the above suggestions have been carried out, a number should be made up as closely alike as is possible to determine and then each should be tried carefully to see if they all give the same results; if not, those which vary should be thrown out and others substituted till eighteen or twenty are obtained, which are as nearly alike as possible as to their strength of transmission. It is possible that these are not giving the best possible service, so leave several as they were and vary the distance between electrodes in the others, getting several different distances both greater and less than the original distance. Now try these against each other, using the same grade of granular carbon and pick out the best. In the next test vary the quantity of granular carbon. Then vary the size or grade of granular carbon, and finally sift the investigation till the best is found. It is possible to get a distance between electrodes so close that the granules pack too easily and still have the transmitter talk louder than the rest, but this must be allowed for, as it is better to sacrifice a little loudness in order to secure freedom from packing. Then there is the articulation test, which is the test as to whether a party at the far end of the line can understand perfectly. In making this test, unusual words with many consonants are given; the listening party should not have any knowledge of what the words are to be, nor should he be able to guess from the sense of the conversation. Figures are good to use. Make up a list and have the listening party copy them, then compare the two lists. In making the test, between instruments, the circuit should be connected so that the tester may quickly shift from one to the other, as otherwise it will not be possible to distinguish small differences. The ear has a very short memory. It is not possible to get good results when the party doing the talking is also doing the listening. The sound of his own voice will confuse him, and, then, knowing which instrument he is using he will be apt to be prejudiced. It takes two to make a proper test, the one to be out of sight and hearing of the other. The party listening should not know which instrument is being tested. In this manner, by making dozens of combinations and changes, the transmitter question may be thrashed out. It is not the question of a day to make a decision, but one of months of patient and careful investigation. The instruments should be tested over long lines as well as short ones. It may be said that a transmitter working well over a short line and a long one will work well on all intermediate distances.

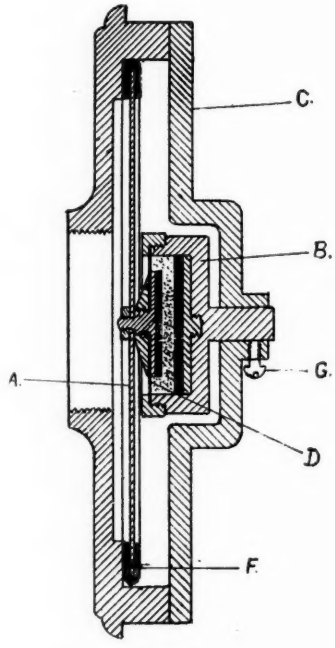


FIG. 4.

THE RECEIVER.

After the transmitter the receiver is next in importance toward the success of a telephone. Nearly all the receivers now in use by independent telephone companies are of the two-pole type.

The double-pole receiver consists of a horseshoe-shaped piece of steel strongly magnetized with Norway or Swedish iron pole-pieces upon which the coils of wire are wound. The ends of the poles are placed as closely as possible to a thin iron diaphragm. Fig. 5 shows a sketch of the magnets which is usually used, and includes the iron pole-pieces. A represents the permanent magnet which has a cross-section, as shown in D. This steel is usually five-eighths of an inch wide and one-fourth of an inch thick. E represents the cross-section of another shape of the steel which was used extensively some years ago and has largely fallen into disuse, not because it is of poorer grade, but because the other shape is usually sold cheaper.

The permanent magnet is usually formed up in a punch press, being heated red hot first. It is difficult to bend the steel cold on account of the shortness of the turn. After the magnet has been properly formed and the machining necessary is finished it is heated to a cherry red color and plunged into cold water. In doing this tempering the magnet is held in the tongs at the two ends, a gauge having been placed between to prevent the two legs from pressing together. If the magnet is merely thrown into the tank it will warp out of shape and there will be no two of them alike. In chilling the steel it should be agitated rapidly in order to make it cool quickly and uniformly. After the chilling, the magnet is ready

for charging. This is usually done upon a strong electromagnet. This electromagnet has two parallel poles eight or ten inches long and close enough together to allow the receiver magnet legs to span the space between. The poles should be made adjustable so that the air-gap between may be varied for the various sized magnets which it may be necessary to charge.

There are various methods of charging. One way is to place the magnets upright upon the electromagnet and allow half a dozen or more to remain across the poles for a minute or more when they are removed, having first placed a keeper across the poles. Another way is to do in a similar manner, except the magnets are rapped sharply with a mallet, no doubt in order to agitate the molecules in order that they may more readily arrange themselves in

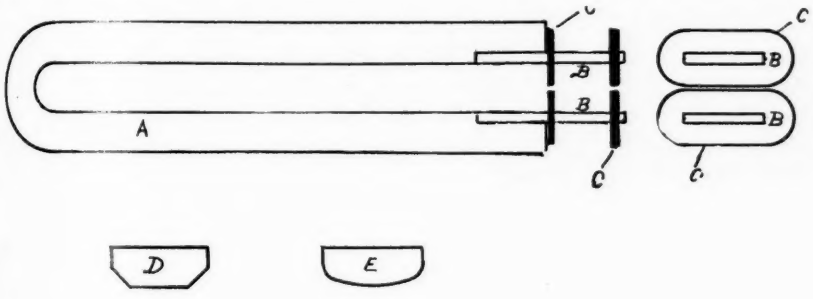


FIG. 5.

the magnetic field. The third way, and the way that the writer has had the most success with, is to magnetize them one at a time, holding them in an upright position and wiping them across the poles of the charging magnet lengthwise, keeping the legs astride the air-gap, then, after wiping in this manner six or eight times, lay the magnet on its side and place a keeper across the poles and remove. In wiping across the poles of the charging magnet lift the magnet at the end of each stroke and return to the starting point. It will not do to open the circuit of the electromagnet when the magnets are charged, as it will almost entirely demagnetize them on account of the strong self-induction current which is set up.

Recently great progress has been made in the manufacture of magnet steel. It is a rather difficult matter to get the steel exactly as it is wished. A noticeable amount of sulphur or phosphorus is very harmful, and there must be the right proportions, manganese and carbon. If not of the right composition, the steel, while it may possess good magnetic qualities, will fly to pieces while tempering, making an expensive loss. The following is an analysis of a first-rate grade of magnet steel:

Silicon not less than $\frac{1}{10}$ %, not more than $\frac{2}{10}$ %.
Sulphur not more than $\frac{5}{100}$ %.
Phosphorus not more than $\frac{7}{100}$ %.
Manganese not less than $\frac{75}{100}$ % or more than 1 %.
Carbon not less than $\frac{56}{100}$ % or more than $\frac{61}{100}$ %.

Steel made after the above specifications will work very nicely for all permanent magnets.

Tungsten steel has been used for this purpose, but it is very expensive and not as strong as the other kind. The main virtue of the Tungsten steel lies in the fact that its magnetism remains of a more uniform strength for a long time. For this reason it is used in the manufacture of electrical measuring instruments where great uniformity is demanded.

The formed receiver magnet in the average double-pole receiver is usually from three to three and one-half inches long, not including the pole-pieces. In the designing of the receiver the magnet must not be made too short or there will be danger from depolarization from the currents passing through the coils. A long magnet will not be influenced beyond a short distance from the poles by any ordinary current which passes through the coils. Now, if the magnet is very short it may be influenced throughout its entire length and the result is a neutral magnet. This is one reason why watch-case receivers give so much trouble from demagnetization.

Part of the magnet are the pole-pieces. These should be thoroughly annealed so as to eliminate residual magnetism, making the magnetic reluctance very low in order that any positive or negative impulse may quickly affect the iron. As before stated, the pole-pieces should be of the finest grade of Norway or Swedish iron, present a small cross-section and be made as thin as is consistent with good mechanical construction. If the poles are thin there is less danger of the neutralizing effect of eddy currents. They should not be placed too close together to avoid magnetic leakage from pole to pole. As a general thing the winding determines the distance. They should be as close as the winding will allow.

In Fig. 5 the pole-pieces are shown by B. In the best cases the dimensions are about one-sixteenth inch thick, one-half inch wide and only long enough to permit the heads, *c*, of the spool and the coil. The heads are of oval shape, and the one next the end is of metal lined with fibre or rubber. The lower head is usually of fibre, and sometimes of metal with fibre or rubber lining. The core B is usually insulated by several turns of paper.

The following is a sample analysis of a good grade of Norway iron used for the cores of telephone electromagnets:

Silicon	.005	per cent.
Sulphur	.000	"
Phosphorus	.000	"
Manganese	.000	"
Carbon	.010	"
Iron	99.985	"
	100.000	"

In annealing the iron the following process is an excellent one. The parts to be annealed are placed into an annealing pot and packed carefully in iron filings or turnings so that none of the parts touches the sides of the pot. The cover is then sealed on with fire-clay and the whole placed into the annealing furnace. The pot is usually made of cast iron, though sometimes of boiler iron. The pot and contents are heated to an almost white heat and kept that way for ten hours when the whole furnace and contents are allowed to cool slowly. If the pots are large, say, about a cubic foot or more, they may be withdrawn from the furnace and allowed to cool on the floor. When entirely cool the articles may be taken out. If these rules are followed carefully the articles will be very soft and almost white. If there is any scale on them the annealing has not been properly done, neither should annealed pieces be blue. It is needless to state that the iron turnings or filings, in which the pieces to be annealed are packed, should be from wrought iron or very low carbon steel. Any material amount of carbon would case-harden the articles.

Credit Where It Is Really Due.

[*From the N. Y. Sun.*]

At last the "hello" girl who is prompt to answer the ring and accurate to give the right number has been discovered in Muscatine, Iowa.—*Albany Argus.*

Fashionable perhaps, but cheap, pernickety and poor tempered. The genus "hello girl" is a marvel of promptness, clear-headedness and attention. She is an honor to her sex. Put yourself in her place and think it over, if you are disposed to fret yourself in the manner of our contemporary in Albany.

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

Pumping Plant for Condensing Water.

The condensation of steam in the large quantities required in electric power stations is often a difficulty in those cases where a central site is selected. Mr. Charles Hopkinson, in a paper read at the Institution of Mechanical Engineers, states that the discharge of aqueous vapor in large quantities is intrinsically and legally a nuisance. This objection has caused trouble to users of cooling towers, and was the reason for abandoning the cooling-tower scheme as part of the Newcastle tramway power plant. As an alternative it was decided to pump from the River Tyne, distant some 500 yards horizontally and eighty-six feet vertically from the engine-house, and to utilize the energy of the water flowing back to the river. Accordingly, after the usual formality of the advertisement and reception of bids the system was adopted, designed to supply at present 75,000 gallons per hour, and to be conveniently capable of supplying from 150,000 to 200,000 gallons per hour. The plant consists of three Mather & Platt single-chamber high-lift centrifugal pumps. These are driven by shunt-wound motors, assisted by turbines on an extension of the pump and armature spindle. In these pumps water enters the revolving wheel axially and symmetrically on each side so that axial thrust is eliminated. The water then traverses the curved internal passages between the veins, and is discharged tangentially at the periphery into a stationary guide ring of special construction. The article is fully illustrated and is supplemented by curve sheets showing the ratio of total head and feet and revolutions per minute, and gallons delivered per minute.—*The Electrician* (London), September 5.

The Nature of the Coherer.

In this note, presented by Mr. J. Fenyi to the French Academy of Sciences, are described the results of an interesting study of a small coherer formed of steel needles. If four of these coherers are placed in parallel they behave as one instrument. This arrangement will work perfectly, provided the potential of the battery does not surpass one-quarter of a volt. With a difference of potential of one volt, it ceases to act. On the contrary, if four of these coherers are placed in series they will work satisfactorily upon a circuit with a difference of potential of one volt. In fact, any voltage can be used successfully by increasing the number of coherers in a proportion of four to each volt difference of the potential in the circuit. The properties of a coherer having only one point of contact can, in a manner, explain the operation of the usual coherer formed of filings or carbon particles. The small particles of metal are placed, as it were, in series. As is well known, the coherer is not a perfect insulator, but allows a small current to pass. There is here a gradual fall of potential from particle to particle, according to their number. These filing coherers can be used in circuits having one or more cells. The behavior of the usual coherer is similar to that of one built up by a series of needle coherers. However, in the first case, the number of contacts is unknown and can not be varied, while by the use of needles the number of contacts can be anything desired. The use of needle coherers, however, gives the experimenter entire control of the sensibility of the instrument and enables him to secure certain results at all times. It is known that sifting the filings increases the sensibility of the coherer. The effect, however, is attributed to the dulling of sharp points by this process, and not to the uniformity of size. Needle coherers work satisfactorily even when a fairly large current is passing through them. This property enables the arrangement of the circuits to be very simple. Thus, a coherer having six points of contact, and placed upon an electric bell which is connected in series in the circuit, will operate satisfactorily. The striking of the bell suffices to decohere the needles. By placing a Morse receiver in parallel with the bell an equipment is obtained which can be used satisfactorily for experiment in the laboratory. An arrangement of this kind will also serve to indicate the approach of distant storms. The experience in the use of this apparatus has shown that its sensibility is determined by the length of the insulated conductor.—*L'Electricien* (Paris), August 9.

Development of Arc Lighting Apparatus from 1810 to 1902.

This first section of a paper read by Mr. W. D'A. Ryan before the Canadian Electrical Association traces the history of arc lighting from 1810 to 1878. The article is fully illustrated and gives an interesting review of the art. Until the invention of the groove cell in 1836, and the Bunsen, in 1842, the voltaic arc was shown as a laboratory experiment only. After the invention of cells which could maintain an arc for a considerable length of time attention was drawn to its possible use for lighting. Many patents were taken out from 1840 to 1860. In the earlier types regulation was by hand only and the lamps of no practical value. In 1847 Staite patented a lamp in which the feed was controlled by the strength of the current. Others of this class followed, Gaiffe, in 1850, introducing a focusing lamp. Siemens brought out his differential solenoid lamp in 1855. This was followed by a number of types, few of which were at all practical. A concise history of the development of the arc machine is then given, beginning with the early form invented by Hyppolite, in 1833, in which a permanent magnet was revolved below a pair of solenoids. Then followed the addition of more solenoids, and the use of more magnets giving the multipolar type of magneto machine which reached its highest development in the famous Alliance machine. An interesting motor built by Elias, in 1842, is described. This was practically two gramme rings, one within the other, but unfortunately it did not occur to the inventor to try the machine as a generator, and the self-exciting dynamo was not discovered until twenty-five years later. The early types of Siemens, Brush and

Thomson-Houston machines are described, and a brief account is given of the various types of "candles" tried in the later seventies.—*The Canadian Electrical News*, September.

The Internal Combustion Engine.

In this article Mr. E. C. de Segundo discusses the application of the internal combustion engine and its advantages. There can be no doubt as to the great future which is opening for the internal combustion engine as a rival to the steam engine, especially owing to the many successful systems of production of gas of low calorific value. Attention is called to the many instances where waste gases of blast furnaces are available. It is calculated that in the whole of Germany, where some 8,000,000 tons of pig iron are made per year, about 600,000 horse-power should be available. The great advantage of the internal combustion engine lies in the wide range of temperature within which it is possible to work, and in the greater possibilities of thermal efficiency as compared with the steam engine. The recent successful application of highly superheated steam has somewhat modified this advantage, but whereas a steam engine, even when working with superheated steam, has reached a stage of development which approaches the limit of possible heat efficiency, the present state of the combustion engine is still within the limit. From certain tests quoted, it is pointed out that one engine gave one brake horse-power-hour, with a heat efficiency of 23.73 per cent, while in another case the heat efficiency was 25.6 per cent. In the case of a triple-expansion engine, using slightly superheated steam, the indicated heat efficiency was between seventeen and eighteen per cent. The mechanical efficiency was about eighty-five per cent, thus giving a brake heat efficiency of only fifteen and one-half per cent. Mr. C. J. Hobbs has given a calculation of the thermal efficiency of the ideal engine, working under temperature conditions which obtained in these steam trials. The ideal efficiency was found to be 24.2 per cent, making the actual efficiency ratio 75.77 per cent. This would appear to leave a considerable margin for improvement in the steam engine. With more highly superheated steam better results would have been realized.—*Electrical Review* (London), August 29.

Economy in the Use of Oil.

To obtain economical results there should be a uniform method of taking care of journal boxes in the several yards of any large railroad system. But so far as the writer, Mr. S. J. Dillon, has been able to observe, each yard foreman seems to have a system of his own. The men who take care of journal boxes should be intelligent and reliable. The oil-house and its accessories should be kept in a neat and clean condition. Instructions to men should be plain and, where possible, accompanied by intelligent drawings or diagrams demonstrating the practice to be followed. A complete record should be kept of the hot journals occurring in the territory for which the oilers are responsible, and each journal which is chargeable to the oiler marked up against his record in the oil-house, where it is constantly before him. A very important factor in the care of journal boxes is to see that none of the old packing removed is thrown away. All the old waste removed is accumulated and the oil extracted which is used for soaking the waste. An illustration accompanying the original article shows an oil extractor which has been used with great success. This consists of an air-tight wooden box of any desired dimensions, inside of which is an oil-tight iron box with steam pipes built up on all sides. The old waste is placed in the iron box about three-quarters of the way to the bottom of this iron box and gauze is suspended, forming a tray upon which is placed the old waste. The portion of the iron box beneath the netting becomes an oil chamber into which the filtered oil drops under the heating of the waste. A pipe and spigot connect the iron box with another box adjacent, in which is placed a pail which gathers the oil. By this method the old waste is made perfectly dry and in such a condition that the dirt or sand is easily removed, and it is said to give much better satisfaction than the squeezing method which has been used quite extensively.—*The Railroad Gazette* (New York), September 14.

Maintenance of Electric Accumulators for Traction.

Accumulators have been made the scapegoat for all automobile troubles. In petrol motors stoppages are attributed to failure to ignite, in electric motors, the battery is exhausted. That these troubles are largely due to neglect is the contention of Mr. A. Delasalle in this article, and he gives an excellent set of rules for the proper care of the batteries. Batteries used with petrol motors for ignition should be small and light and capable of retaining their charge for a long time. The same care is needed as for those used for operating electric motors. It is important that they should not be left standing on closed circuit. They should never be tested by connecting an ammeter across the terminals as this indication means nothing and is injurious to the battery. Batteries used for electric motors are always of the Faure type. The density of the electrolyte should not be more than 28-29 degrees Baumé, and not 32-30, as is often the case. While this latter density gives a higher voltage it is more apt to cause sulphation. The battery should only be taken out when both the capacity and the allowable rate of discharge are sufficient for the trip. When a stop becomes inevitable it is better to stop at the first suitable place rather than completely discharge the batteries and thus make any further movement impossible. The most frequent source of trouble is sulphation of the batteries. This can generally be cured by charging at the rate of one-half to one ampere per square decimetre of anode surface in an electrolyte of 10-12 degrees Baumé. After charge, remove the electrolyte and replace with normal. If this is not successful charge in an electrolyte of three to four degrees Baumé, to which add sulphate of soda to bring the density up to ten degrees. If this is not successful, completely discharge by short-circuiting and then charge in the opposite direction. After fully charging, slowly discharge and recharge normally. This method never fails, but requires skill and care. Excessive discharging may loosen particles of active material and, these falling out, may short-circuit the plates. This fault should always be watched for. Faure cells should be inspected after every fifty discharges, Planté cells after every 100 discharges. Short-circuits are easily detected by the voltmeter, the faulty cell showing a lower voltage and lower resistance than the others. Occasionally it is necessary to brush the plates to remove the sulphate. When the plates are in good condition the positive is a black brown and the active material hard. The negative is bright; the active material should easily pass a pin. If it is necessary to let the battery stand for a long time, either fully charge and then replace the electrolyte by distilled water or discharge the battery until the voltage is not more than 1.2 per cell, then draw off the electrolyte and wash the plates with water.—*L'Electricien* (Paris), August 23.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Manufacture of Incandescent Lamps.

While the process of manufacturing incandescent lamps may be well known to a large number of the average readers, it will probably be of great interest to many

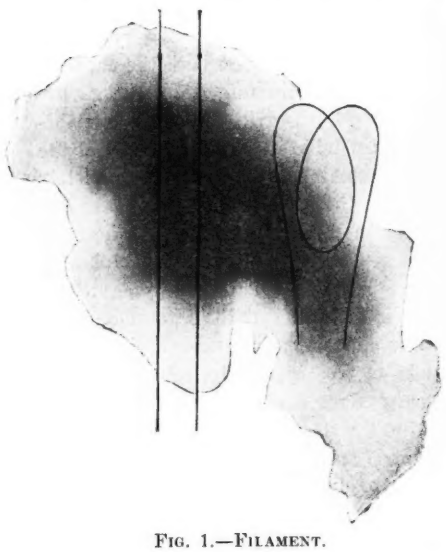


FIG. 1.—FILAMENT.

to become acquainted with the methods employed by the manufacturer of a standard lamp which has, for a long period, held a very popular place on the market. Technical publications have from time to time described the manufacture of this important piece of electrical apparatus, but the manufacturer, as a rule, has not disclosed in detail the structural course of procedure.

The Sawyer-Man Electric Company, New York city, has recently produced a booklet describing incandescent lamps. In addition to the fact that the book is a handsome addition to the literature on this subject, it embodies many features which make it especially valuable to any one interested in electrical progress. A brief introduction relates the more important facts, describing the development of the incandescent lamp, with which the names of Sawyer and Man have been closely associated from the beginning. An historical sketch describes and illustrates the evolution of the incandescent lamp from its first inception.

A chapter on how an electric lamp is made is probably that which will interest the general reader to the greatest extent. The nature and relation of the parts of a lamp, and the duty each has to perform, are touched upon in this sketch. From this the reader will see that the incandescent lamp, although delicate in appearance, is simple in principle and amply provided with strength in every particular. The filament, or thread of carbon, which is the source of light, is the most interesting and by far the most important detail. As the result of twenty years of careful investigating and experimenting, a filament is now made which is so tough that it is not affected in any way by the rough usage to which it is subjected during the life of the lamp, so elastic that when forced out of its moulded shape it will spring back like steel wire, and so enduring that in the finished lamp it will glow with almost undiminished brilliancy

FIG. 2.—SHORT TUBE BEFORE FUSING IN THE PLATINUM LEADING-IN WIRES.

for many hundred hours at a temperature of from 1,500 to 1,600 degrees centigrade.

To form the filaments a solution of cellulose is squirted through dies, emerging from the dies in the form of fine threads, which, when dried, are tough and flexible. After being formed into the shapes desired for use in the lamps, the threads of cellulose are packed in crucibles with carbon dust, and subjected to intense heat for many hours, which completely chars the cellulose and, so to speak, leaves only the carbon skeleton of each thread.

Fig. 1 shows the cellulose filament as it is squirted from the dies and also after it has been moulded into the form in which it is to be used in the lamp.

The carbon skeleton thus formed is not immediately a serviceable material. Certain mechanical weaknesses make further treatment necessary. This consists in suspending the filament in an atmosphere of hydrocarbon vapor, at a pressure reduced considerably below that of the atmosphere by means of an air pump. Then there is passed through the filament for a half second a current of electricity of sufficient strength to bring it to incandescence. At this very high temperature the hydrocarbon vapor is decomposed, carbon in a form resembling graphite being deposited on the filament. Before treating, all filaments vary more or less in diameter. At points of smaller diameter the resistance is greater, and more heat is generated than at other parts of the filament. These points, being at a higher temperature, would disintegrate and break long before the rest of the carbon had served its useful life. During the process of treatment, however, these hotter portions decompose the vapor more rapidly than the rest of the filament does, and it follows that in this manner they are built up by the deposited carbon. The result of this process is that the thread now possesses a remarkably uniform structure. This method of treating filaments was first made use of by Sawyer and Man in March, 1878.

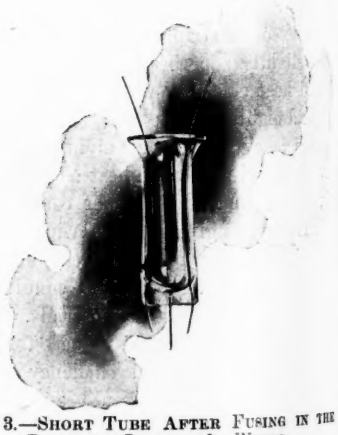


FIG. 3.—SHORT TUBE AFTER FUSING IN THE PLATINUM LEADING-IN WIRES.

Before treatment the filament has a glossy, jet-black surface; after treatment it has a metallic lustre resembling polished steel. This metallic surface radiates heat less readily than a black surface, and, consequently, for a given expenditure of electric energy a larger amount of carbon can be kept hot. The increase

in the mass of carbon thus made possible is an advantage in two ways: It enables the lamp maker to use a thicker and more substantial filament, and this filament, having a greater surface, need not be kept at quite so high a temperature to give equal light. An illustration of the importance of this difference in temperature is the fact that a lamp burning at 1,550 degrees centigrade is claimed to burn ten times as long as a lamp burning at 1,605 degrees centigrade.

As oxygen in any quantity is a supporter of combustion, it is necessary that the carbon filament be burned in a vacuum in order that its life may be as long as possible. Accordingly, it is necessary to exhaust all the air from the bulb of the lamp, and to conduct the electric current through the glass by means of an air-tight joint. This can be satisfactorily accomplished by the use of platinum, to which fused glass adheres very firmly, and which has the peculiar characteristic that in cooling it contracts at the same rate as the cooling glass. Many other metals and compositions have been experimented with, but it has been found that the differing rates with which the glass and metal contracted either caused the glass to crack or would leave a minute space

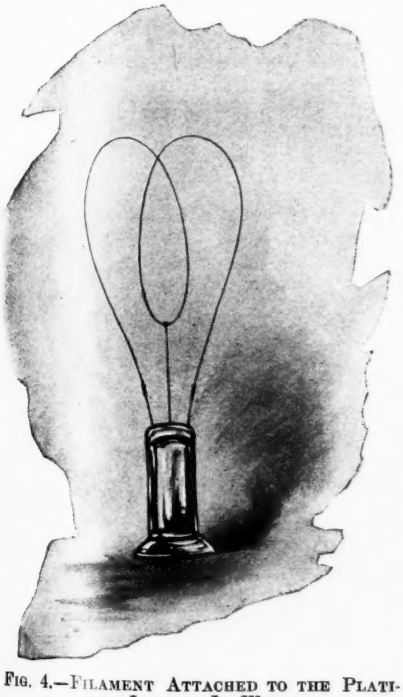


FIG. 4.—FILAMENT ATTACHED TO THE PLATINUM LEADING-IN WIRES.

between the platinum and the glass which would allow the entrance of sufficient current to very quickly deteriorate the service of the filament. Platinum being a very expensive metal, it is desirable to use as little as possible. Hence short pieces of platinum wire are fused to the ends of longer copper wires. Two of these platinum tips are then fused or sealed into the end of a bit of glass tubing having a flange spun on one end from which the copper wires are left protruding. This combination is now called the mount, or stem. A nickel wire is fastened into the fused end of the glass tube between the platinum wires in mounts which are intended for loop filaments. This nickel wire serves as an anchor to prevent excessive vibration and consequent breakage, as well as drooping of the carbon when placed in the horizontal position. Fig. 2 shows the bit of glass tubing; Fig. 3 showing the tubing with the copper wires fused to the platinum, and the nickel supporting wire in the centre. At this stage of the process

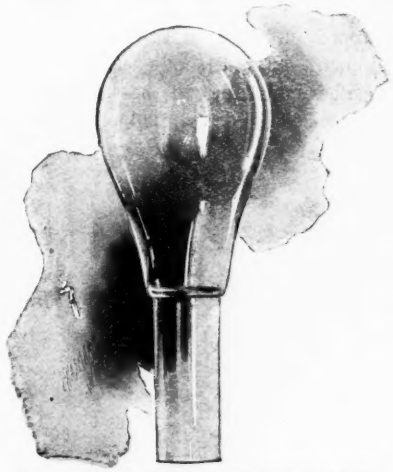


FIG. 5.—AS THE BULB COMES FROM THE GLASS-HOUSE.

the glass has been brought to a condition of plasticity and firmly amalgamated with the platinum leading-in wires.

The next operation consists of fastening the filament to the mount. This is temporarily accomplished by means of a special composition which will stand a red heat, and which will give off no gases when the lamp is burning. This latter point is important, inasmuch as such gases would impair the life of the lamp and cause rapid deterioration in candle-power. Over this paste is deposited a layer of carbon very similar to the carbon deposited during the treatment of the filament, although in this case the filament is locally heated at the point of union with the platinum in a bath of liquid hydrocarbon. This deposited carbon ensures a joint that is both mechanically and electrically perfect. The filament is now anchored, except in lamps having short, stiff carbons requiring no support. The process of anchoring is accomplished by bending the end of the nickel wire into a small hook, and placing in this the loop of the filament, holding the latter in place by means of a drop of the composition already referred to. The mount is then

FIG. 6.—THE BULB SHAPED OFF AND READY FOR THE FILAMENT AND MOUNT.

placed in an oven to dry the paste thoroughly. The filament, next straightened by bending the platinum leading-in wire and the anchoring wire, is now ready to be sealed into the bulb. Fig. 4 shows the filament and leading-in wires ready to be sealed into the bulb.

Bulbs are blown in moulds, a practice that ensures exact uniformity in size and shape. As they come from the glass-house they are perfectly smooth at the rounded end, and have a long neck which is cut off with the aid of a glass-worker's file. To the round end is fused a short length of glass tubing, opening into the interior of the bulb. This is used subsequently to connect the lamp to the pump that exhausts the air. Fig. 5 shows the bulb as it comes from the glass-house.

Into the bulb thus prepared is forced the mounted carbon. The flange in the mount is brought even with the edge of the neck of the bulb, and the two are fused together. After being tested for leaks arising from imperfections in the glass-work, and inspected for any defects in the bulb, mount, or shape of the filament, the lamps are delivered to the exhausting department. The exhaustion of air is accomplished by means of a highly perfected mechanical pump constructed especially for this work. The last traces of air or gas are removed by chemical means. When the vacuum is sufficiently high, the tube

through which the air has been exhausted is sealed off by means of a small hand torch, leaving the small rounded tip seen on the spherical end of the bulb. Fig. 6 shows the tube fused to the rounded end, and Fig. 7 the lamp just before the tube is separated from the rounded end.

The lamps are further tested for vacuum

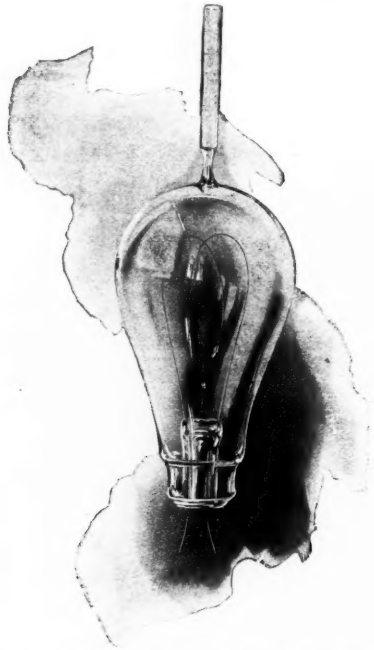


FIG. 7.—THE FILAMENT AND MOUNT SEALED IN AND THE BULB READY FOR EXHAUSTION.

by electrical means, which enables the operator to ascertain at a glance whether or not the lamp is defective in this respect. Also, to preclude the possibility of using any filament which is spotted—that is, of which portions will burn more brightly than the rest, and will prematurely break at these bright points—the lamps are rapidly lighted and extinguished, being made to glow dimly at first, and eventually quite brightly. The practised eye of an expert inspector detects the slightest imperfection, and the lamp is accordingly rejected. The filaments are now measured for candle-power. For this purpose each lamp is separately subject to a comparimeter and photometer test. Here is determined the exact voltage at which each lamp will give its normal candle-power, as well as the amount of current which it will consume in proper service. The illuminating power of the lamp is measured in the horizontal plane while the lamp is rotating around its own axis at 180 revolutions per minute. This rotation ensures an exact determination of the average illumination of the lamp in all horizontal directions.

The lamp at this point is practically completed, with the exception of being fastened to one of the many standard bases which have been developed along with the development of the lamp bulb. A great many types of lamp fittings are now in general use. These are attached to the lamps by means of a cement which is applied at the points where the middle of the base touches the glass. Plaster of paris fastenings have been almost exclusively used, but in the manufacture of the particular lamp we are describing this has given way to a peculiar composition which is claimed to have many points of excellence. After the lamps have been attached to the bases, the leading-in wires are trimmed off and soldered to the bases. The lamps are then lighted to detect either broken wires or short-circuits, and sent to the shipping department. Here they are tested, cleaned, polished, labeled, wrapped in tissue paper and packed for shipment. Fig. 8 shows the lamp ready to be cemented into the base.

The detailed description of the manu-

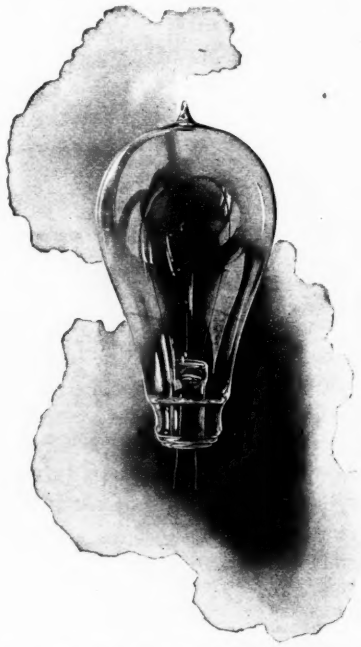


FIG. 8.—THE COMPLETE LAMP—READY FOR CEMENTING INTO THE BASE.

facture of an incandescent lamp is supplemented by many suggestions for those who use incandescent lamps, and the whole book is well worth careful perusal.

Bulletin of the French Society of Civil Engineers.

The July number of the *Mémoires* of the French Society of Civil Engineers has been issued. This contains a long and fully illustrated study of the metallurgy of iron and steel as shown by the many exhibits at the Dusseldorf Exposition.

Insulators for High Potentials.

One of the greatest troubles with which the engineer has had to contend in winter, when insulators, pins, cross-arms and poles became soaked with water, was the inevitable electrical breakdown. The dripping of water from exposed por-

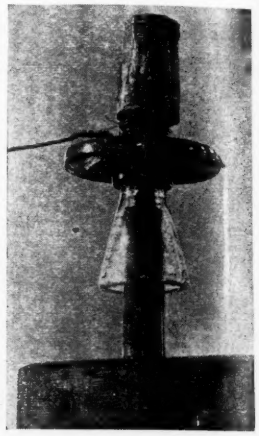


FIG. 1.—THE WATER RUNS OFF IN A SOLID STREAM AT NO VOLTAGE.

tions and the seepage along the edges of the large and heavy insulators gave rise to electrical leakages that were the sure forerunners of trouble. The accompanying illustrations are reproductions of half-tones from the description of the Bay Counties' system, published by the *Journal of Electricity, Power and Gas,* of San Francisco, Cal., and show what has resulted from a careful study of these conditions and a determined effort to supply a remedy. This consists in having a rim placed around the edge

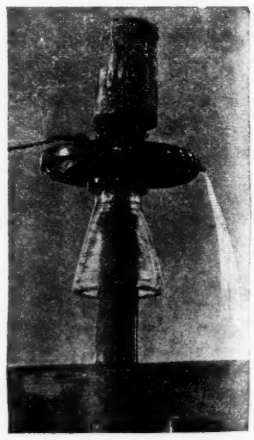


FIG. 2.—HOW THE WATER IS SPLIT UP AT 40,000 VOLTS.

of the top piece of the insulator, in which the water is collected and run off as a solid stream from the spout. While, of course, the stream ran off in just an ordinary manner when the insulator was subject to no electrical pressure, the water was scattered outwardly as a spray when

it was subjected to a high-potential charge. Mr. E. E. Starke secured the photograph from which these half-tones were made. The Locke "Victor" insulator, such as that used on the Bay Counties' high-tension lines, was mounted on a pin and cross-arm after the customary manner, and a leaking tin-can placed upon its top gave improvised rain. Fig. 1 shows how the water falls in a solid stream when no electrical potential is on the insulator. Fig. 2 shows how the same stream is scattered when a potential of 40,000 volts is applied to the insulator—scattered because the particles of water have each become electrified to a like polarity. As a result, the end portions of the insulators are always dry, and transmission at extremely high potentials becomes an assured and successful reality. Fig. 3 shows a saddle insulator under test. The insulator shown in the foreground is one of the great Locke porcelain insulators, weighing approximately fifty pounds each, and which after being installed in the Bay Counties' system have withstood long-continued tests of 120,000 volts. A test of 120,000 volts applied to an insulator to be used on a 60,000-volt line gives a factor of four, for inasmuch as two insulators are in series across the line, each is subjected to but 30,000 volts. These insulators are manufactured by Fred M. Locke, of Victor, N. Y., and are adapted to all potentials from 25,000 to 100,000 volts actual line voltage.

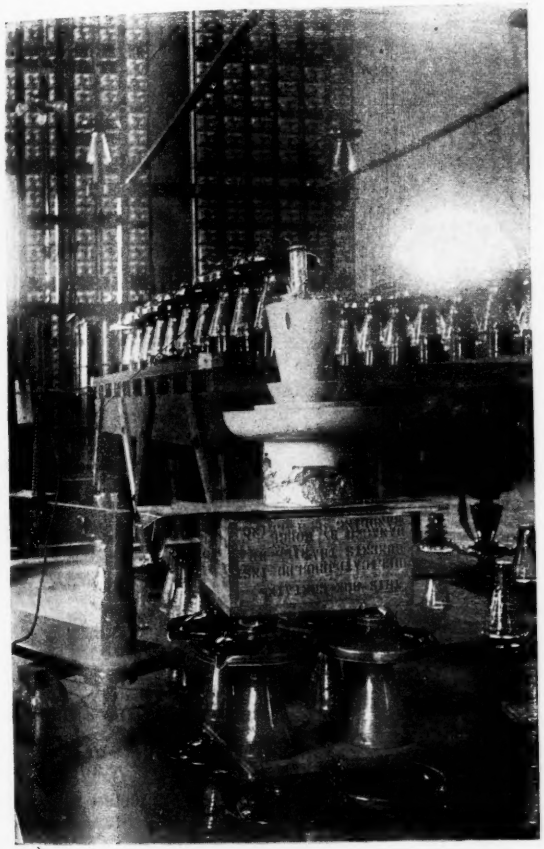


FIG. 3.—A HIGH-TENSION SADDLE INSULATOR UNDER TEST OF 120,000 VOLTS.

An Ingenious Screw-Holder and Driver.

An ingenious screw-holder and screw-driver has been designed by a gentleman from Louisville, Ky., a Mr. J. S. Borden. The apparatus consists of a small tray, in which are formed lateral grooves wide enough apart and deep enough to hold the shank of a screw, the head resting upon the extremities of the partitions forming the grooves. A box of screws can be poured into this tray, and with two or three shakes every screw falls into position. The screws naturally are distributed head up, so that the screw-driver, which is of a novel construction, may readily take hold. A spring collar projects beyond the driving end of the screw-driver, and upon being pressed down over the head of the screw the spring closes the flange and lifts up the screw so that it may be centered and screwed until the pressure comes on. At this point the screw-driver proper turns a half or quarter revolution, whichever may be necessary, and seats itself firmly in the slot in the head of the screw, the collar meanwhile guiding and steadying the screw-driver and keeping the contact positive until the screw is driven firmly home. Mr. Borden has used this outfit at the plant of James Clark, Jr., & Company, Louisville, Ky., manufacturer of dynamos and motors, for some time on assembling brush-holders, and has found it a great time saver and a practicable tool in every respect.

American Institute of Electrical Engineers.

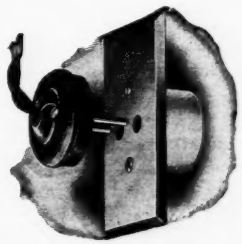
The 168th meeting of the American Institute of Electrical Engineers was held at 12 West Thirty-first street, New York city, Friday, September 26. At this meeting the new board of officers entered upon its duties, and an address was delivered by Mr. Charles F. Scott, the incoming president. A paper was presented by Mr. B. J. Lamme, of Pittsburg, on the "Washington, Baltimore & Annapolis Single-Phase Railway."

Members who have not yet received their bound volumes for 1901 should send proper shipping directions to the secretary.

New Style Plug and Receptacle.

A unique style of plug and receptacle, which is designed as a rosette plug and receptacle, has recently been perfected and is now being placed in the market.

It is claimed to consist of fewer parts than any other device of this kind, and at the same time is very durable and efficient. As shown by the illustration, there is a face-plate of liberal size, on the back of which is attached a small porcelain cup. The contacts are on the front of the cup, so that it can be wired conveniently from the back. The receptacle can be used either in old work or standard conduit boxes. When the plug is in, the appearance is of a chocolate rosette in the centre of a finely finished, rectangular or round brass plate, as ordered. When the plug is removed the plate shows two small holes. The maker, Marshall-Sanders Company, of Boston, Mass., reports a very brisk demand for these goods, although but few samples have been sent out so far.



NEW STYLE PLUG AND RECEPTACLE.

Electrical Exhibits at the Convention of the International Association of Fire Engineers.

At the thirtieth annual convention of the International Association of Fire Engineers, held in the Grand Central Palace, New York city, September 16, 17, 18 and 19, there were shown a number of very interesting electrical exhibits. Not a small part of the fire-fighter's stock in trade consist in auxiliaries in which appurtenances exclusively known as electrical are in constant use. Among the well-known electrical manufacturing concerns which were represented are the following: The Ajax Motor Vehicle Company, the Electric Contract Company, Fyricide Manufacturing Company, Gamewell Fire Alarm and Telegraph Company, Gutta-Percha and Rubber Manufacturing Company, Monarch Fire Appliance Company, Montauk Fire Detecting Wire Company, Magneto Electric Company, United States Long-Distance Automobile Company, of New York city, and the India Rubber Company, of Akron, Ohio.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

POWER COMPANY FOR ALASKA—The Juneau Power Company, Juneau, Alaska, is reported to be about to construct a 10,000-horse-power plant.

LARGE POWER PLANT FOR CALIFORNIA—It is proposed to develop 500,000 horse-power at the Pitt River installation of the Northern California Power Company. Two hundred and fifty inches of water have been appropriated from Pitt River, and 4,000 cubic feet of water per second will be conveyed twenty-eight miles, giving a fall of 1,300 feet on the power-creating wheels. The new plant will be independent of the Shingletown and Cow Creek plants now operated by the company. The new plant will have feeders for long-distance supply, lines being run as far south as San Francisco and north into Oregon. Surveys have already been made, and the company's engineers are now at work on the river, actual work having already been begun.

LARGE POWER PLANT FOR MINNEAPOLIS—The contract for the erection of the superstructure of the large power-house for the Twin City Rapid Transit Company has been awarded to a local contractor. When completed, with all of the machinery installed, the total cost will be nearly $1,000,000, the building alone costing $350,000. It will be one of the most thoroughly modern steam plants in the city, no water power of any description being used. The new building will be two stories in height, and 155 feet square. The power-house will be built for five engines and generators, each of 9,000 horse-power. The present power-house, which the company maintains, has a capacity of 10,000 horse-power. This will be continued as heretofore after the erection of the new plant.

UNION TRACTION PROFITS—At the annual meeting of the stockholders of the Union Traction Company, Chicago, the report of the president, giving the results of the year's operation, showed the entire receipts to be $14,118,158.30; operating expenses, licenses, taxes, fixed charges, etc., $13,040,119.77, leaving a net profit of $1,078,038.53. Operating expenses, including taxes, licenses, etc., were 52.30 per cent, as against 51.74 per cent for last year, a difference of 0.66 per cent. The trackage owned by the company July 1 is estimated to be 475.45 miles. The treasurer's report was also submitted. The balance on hand June 30, 1901, amounted to $194,507.87, and receipts $15,250,034.38, making a total of $15,444,642.45. Expenditures were $15,214,178.32, leaving a cash balance of $230,463.92.

EMINENT DOMAIN FOR TELEPHONE LINES—The Hon. John A. Weiss, associate judge of the courts of Dauphin County, Pa., has handed down a decision in which he declares that telephone companies have the right of eminent domain in Pennsylvania, under the act of 1874. This decision grew out of a suit brought by the Pennsylvania Telephone Company against a party living near Elizabethville, to restrain him from interfering with the construction of the line between Elizabethville and Tremont. Permission had been received to locate the line upon private land, subject to approval, but not to put up the line until the telephone company had paid $5 a pole, which it declined to do. This is the first time the question of eminent domain for telephone companies has been decided in Pennsylvania.

WATER POWER PLANT FOR PORTO RICO—A project is under way for the building of a dam and power-house on the Rio Plato, Porto Rico—located in the mountains about seventeen miles from the city of San Juan, the construction of a transmission line from the power plant to San Juan, and a substation in that city. The hydraulic plant will have an initial capacity of about 1,600 horse-power, but it is proposed to construct a number of large dams, so that the plant will be considerably enlarged eventually. The Rio Plato Electric Company, which has been organized for the purpose of carrying out these undertakings, will also take over the Lug Electrica, a San Juan electric lighting station of some 800 horse-power. To carry out these undertakings will require an expenditure of nearly a million dollars.

ELECTRICAL DEALERS' ASSOCIATION DISSOLVED (?)—It has been announced that at a meeting held on Wednesday, September 17, at the headquarters, 39 Cortlandt street, New York city, the eastern branch of the Electrical Supply Dealers' Association was dissolved. The Electrical Supply Dealers' Association was fined $1,000 in May last in a suit instituted by Attorney-General Knox under the Sherman anti-trust law, independent dealers in the West having filed complaints. It was claimed that the association was originally organized for social purposes. It was afterward ascertained that it would be advantageous to many dealers in the electrical supply business if something were done to make the prices of the various patented articles uniform. An understanding was arrived at, and it has been operative for some time past. Recently same dissatisfaction among different jobbers, principally in the West, arose, and the organization has therefore decided not to attempt to control the prices of any patented manufactured article.

HAWAIIAN CABLE READY—The submarine telegraph cable which is to join the United States and Hawaii as the first link in the system to the Philippines has now been completed, and is on board the steamer Silvertown. The vessel was scheduled to sail September 20 for San Francisco. From this point the vessel will immediately begin laying the cable to Honolulu. The Silvertown is expected to reach San Francisco early in December. The cable was wound around three enormous spools, each thirty feet in diameter, its total length being 2,413 miles. The shipment of the cable ensures a speedy completion of telegraphic communication with Honolulu and the United States. The manufacture of the remaining three sections to the Philippines is proceeding at the rate of fifty miles a day, and the contracting company feels confident that this will be finished by the early summer of next year. Pending the arrival of the Silvertown at San Francisco, work will be pushed on the underground cable approaches, and also at Honolulu.

TELEPHONE AND TELEGRAPH.

HAMBURG, N. Y.—The Hamburg Telephone Company has sold its stock to the Haines Telephone Company, and it is expected it will soon connect with the Frontier company, of Buffalo.

LEXINGTON, VA.—The Rockbridge Mutual Telephone Company, with main office at Collierstown, has been granted a charter. Major A. Elkhart is secretary and treasurer of the company.

DOVER, DEL.—The work of extending the lines of the Diamond State Telephone Company through Somerset County is being pushed rapidly, and it is expected will be completed within a few weeks.

FRANKFORT, IND.—A mortgage for $1,000,000 given by the new long-distance telephone company to the Union Trust Company has been recorded. The money will be used by the company in improving its service.

CHARLOTTE, N. C.—The board of aldermen has decided to grant the Southern Bell Telephone Company permission to place underground all its wires in this city. The company will begin work on the new system in the near future and expects to effect the alteration in a year.

LEBANON, PA.—The Lebanon township committee has granted a franchise to the Merchants and Farmers' Telephone and Telegraph Company, and the following towns are to be connected: Clinton, Glen Gardner, Spruce Run, Woodglen, Anthony, High Bridge, Bunnvale, Califon, Junction, New Hampton and Changewater.

YORK, PA.—By the consummation of a deal of the independent telephone companies of Maryland and York, York now has direct communication with Baltimore, Philadelphia, Wilmington, Charleston and other cities in Maryland, Pennsylvania, Delaware, Virginia and West Virginia. The lines of the combined company will meet at the Maryland and Pennsylvania border.

ELECTRICAL SECURITIES.

In spite of the noted improvement in the monetary condition, considerable apprehension existed at the close of business for the week, caused solely by the expected poor bank statement, which showed the predicted deficit in the surplus reserve item. Notwithstanding the fact that the close of the week previous showed a condition of apprehension regarding monetary stringency, there is a feeling of greater easiness, and this stimulating influence has been brought by the decrease in percentage for call money. At the beginning of the week call rates ruled at fifteen and twenty per cent, with the bulk of the business done at twelve per cent, and much at fifteen per cent. Toward the end of the week, however, the average was six and eight per cent, with the bulk of business done at seven and seven and one-half per cent. It was only natural that this betterment should have given courage both to bull operators and pools, and also acted as a check to any volume of liquidation. While the outlook is for very firm money for a short time, it must be remembered that but little of the $16,000,000 or $17,000,000 which Secretary Shaw estimates was released by the government last week has yet found its way into banking channels, and a very small proportion of last week's gold engagements of $8,000,000 has become available. This aid will undoubtedly prove sufficient to keep the money market from developing into anything but temporary stringency.

An important factor in the outlook for the immediate future is the greatly improved crop reports over those of last year. Experts also predict that there will be a large increase in the volume of exports, owing to this greatly improved outlook, and the country will probably be in an excellent condition to pay off its foreign obligations without gold exports. At the same time, large crops here and poor foreign harvests make it certain that the amount will be large, and will be heavily swelled by big cotton exports if that crop comes up to recent estimates.

As November approaches, the question of a tariff reform and the possibility of dissension in the dominant political party will certainly grow in importance as a stock market factor, and especially if general opinion to any extent favors a possibility of a change in control of Congress.

The coal strike occupies a very material portion of speculative attention. No one can now dispute the fact that it is one of the most important checks to any extended bull movement which is now in evidence. While some official reports from different situations set forth the possibility of the operatives and coal-moving railroads getting more of the product to market, it does not seem, from an authoritative point of view, that there is much improvement over the condition which has existed for some weeks past.

ELECTRICAL SECURITIES FOR THE WEEK ENDING SEPTEMBER 20.

New York:	Closing.
Brooklyn Rapid Transit	68¼
Continental Gas	223½
General Electric	195
Kings County Electric	212
Manhattan Elevated	138
Metropolitan Street Railway	147¼
New York & New Jersey Telephone Co.	183
Westinghouse Manufacturing Co.	225

General Electric, Manhattan Elevated and Metropolitan Street Railway under favorable buying made substantial increases. Westinghouse toward the end of the week suffered a slight relapse and dropped a couple of points.

New York & New Jersey Telephone has maintained the activity of a week ago, sales having been reported during the week at 184½.

Westinghouse Electric and Manufacturing Company will pay a quarterly dividend of 1¾ per cent upon the preferred stock of the company October 1, 1902.

The General Electric Company will pay to holders of common stock a dividend of $2 per share on October 15 next.

Boston:	Closing.
American Telephone and Telegraph	171
Edison Electric	275
Massachusetts Electric preferred	96
New England Telephone	141
Western Telephone and Telegraph	100½

There has been considerable credence given the recent rumor concerning a deal being worked out by interested parties, involving the gas and electric lighting companies in the city of Boston and vicinity. A clause in the charter of the Brookline Gas Company permits it to do an electric as well as a gas lighting business, and it is already doing such a business in certain districts outside of the city proper.

There has been considerable talk of late of merging all of the electric light and gas companies in and around Boston into one large corporation, which would make electric lighting the exclusive form of illumination in that vicinity.

Philadelphia:	Closing.
Electric Company of America	9¾
Electric Storage Battery common	89
Electric Storage Battery preferred	88
Philadelphia Electric	9 3/16
Union Traction	48
United G. I.	114½

Philadelphia Electric and Philadelphia Rapid Transit were among the features in the local market during the week. On Friday, Philadelphia Electric Company led the market, rising to 9½. Reports of the possible merger of Philadelphia Electric and Rapid Transit were repeated freely, but there was no official sanction apparently for these statements. Electric Company of America was fractionally higher, and the balance of electrical securities were also in evidence during the week.

The directors of the United G. I. Company have declared a quarterly dividend of two per cent, payable October 15, 1902.

Chicago:	Closing.
Chicago Edison Light	175
Chicago Telephone	171
Metropolitan Elevated preferred	90¼
National Carbon	33
National Carbon preferred	101½
Union Traction	20
Union Traction preferred	56

Union Traction was one of the predominant features of the local market for the week, the issue being handled at 20 for the common and 56 for the preferred.

PERSONAL MENTION.

MR. C. B. PRICE, of the Pettingill-Andrews Company, Boston, Mass., was a visitor in New York city during last week.

MR. CHARLES SPRAGUE, of the Chase-Shawmut Company, Boston, Mass., has been spending the last two weeks of September in the mountains.

MR. A. F. ROOME, New Orleans, La., has been appointed superintendent of all the telegraph lines of the Southern Pacific Company, with headquarters at San Francisco.

MR. N. MARSHALL, president of the Marshall-Sanders Company, Boston, Mass., manufacturers of well-known M.-S. switches, has just returned to Boston from a vacation of several weeks.

MR. A. HALL BERRY, for many years associated with the H. W. Johns Company as manager of the electrical department, has resigned this connection to become interested with F. H. Lovell & Company, New York city, as general manager.

GEORGE L. CRAGG, patent attorney, Chicago, requests that, to remove any erroneous impression which may have been created, we mention that his offices are still where they have been for so many years, namely, at 1450 Monadnock Block, Chicago.

MR. H. DE STEESE has become associated with the Stuart-Howland Company, Boston, Mass., and will have charge of its New York office. Mr. de Steese was formerly with the Western Electric Company, and has a great number of friends in the electric railway field.

MR. E. L. DRAFFEN is now representing the Gould Storage Battery Company, New York city, in the West, with offices in the Rookery Building, Chicago. Mr. Draffen is already well known in the storage battery field through his energetic work in the Cleveland office of the Electric Storage Battery Company, of Philadelphia.

MR. GEORGE C. EWING has resigned from the American Union Electric Company, of New York, and has opened offices in the Board of Trade Building, of Boston, where he will act as the New England representative of the Nernst Lamp Company, of Pittsburg, and also as the selling agent for a general line of street railway supplies. Mr. Ewing, who was president of the Morris Electric Company, one of the companies operated by the American Union Electric Company, advises that he leaves that corporation with the kindliest feeling for its future progress.

NEW INCORPORATIONS.

GRIPNELL, IOWA—Carroll Telephone Company. $5,000.

MERCER, N. J.—The People's Traction Company. $170,000.

ALBANY, N. Y.—The Intervale Traction Company. $300,000.

LANCASTER, PA.—The Lancaster Electric Transmission Company. $500.

SUSQUEHANNA, PA.—Susquehanna County Electric Company. $30,000.

COLUMBUS, OHIO—New Philadelphia Railway Company. $600,000.

NICHOLASVILLE, DEL.—The Jasmine County Home Telephone Company. $50,000.

CHATFIELD, MINN.—The People's Telephone Company. Increased to $150,000.

MINNEAPOLIS, MINN.—The Warren Light and Manufacturing Company. $10,000.

MABIN, MISS.—Mississippi Telephone Company. Increased from $8,000 to $12,000.

ST. PAUL, MINN.—The Mesabe Telephone Company. Increased from $10,000 to $35,000.

KUTZTOWN, PA.—Kutztown Electric Light Company. Increased from $15,000 to $50,000.

SPRINGFIELD, ILL.—De Kalb County Telephone Company. Increased from $50,000 to $100,000.

CINCINNATI, OHIO—The Ada Water, Heat and Light Company. Increased from $25,000 to $75,000.

AUSTIN, TEX.—Farmers' Telephone Company. $7,000. Incorporators: M. D. High, Fred Roach and D. W. Price.

CHESTERFIELD, S. C.—Chesterfield Telephone Company. $3,000. Incorporators: J. A. Welsh, D. S. Teal and others.

WILMINGTON, DEL.—The Jefferson Street Railway Company. $65,000. President, J. A. Whiteman, Punxsutawney.

NEWARK, N. J.—The Ball Check Light Company. $1,000,000. Incorporators: Edward T. Magoffin, Frank R. Serles and Walter H. Bond.

SACRAMENTO, CAL.—Edison Electric Company. $10,000,000. Directors: H. Fisher, J. B. Miller, H. H. Sinclaire, F. B. Hinge and others.

FULTON, N. Y.—Fulton Fuel and Light Company. $125,000. Directors: H. W. Noble and W. E. Moss, Detroit, and J. A. Frost, Fulton.

SPRINGFIELD, ILL.—Lincoln Water and Light Company. $250,000. Incorporators: Ralph Blaisdell, P. B. Warren and George H. Withrow.

PHOENIX, ARIZ.—The Electric Signal Company. $30,000,000. Incorporators: P. A. McClain, H. H. Hallowell and J. O. Foering, of Philadelphia.

MACOMB, ILL.—Macomb & Western Illinois Electric Railway Company. $300,000. Incorporators: D. P. Pennywitt, H. C. Agnew, E. I. Hampton.

JERSEY CITY, N. J.—The Maxwell M. Meyer Electric Company. $100,000. Incorporators: Christian E. Hartshorn, Marshall L. Osgood and Paul E. Hirsch.

CAPE MAY, N. J.—Cape May Light and Power Company. $150,000. Incorporators: Edward C. Brainard, Edward E. Mandeville, James M. E. Hildreth.

DENVER, COL.—Eagle Rock Light and Power Company. $75,000. Directors: William Capp, H. W. Clark, J. F. Sherman, S. P. Dunlap and M. S. Isgig.

DOVER, DEL.—Schuylkill Consolidated Company. $500,000. Incorporators: Josiah Marvel, Andrew Marvel and Frank C. Lupton, of Wilmington, Del.

HUNTINGTON, N. Y.—Town of Huntington Light and Power Company. $75,000. Directors: W. N. Baylis, H. S. Brush and Douglas Conklin, of Huntington.

TOLEDO, OHIO—Bloom-Kloeb Manufacturing Company. $25,000. Incorporators: J. H. Musser, Arthur L. Combs, C. W. Torrance, Walter B. Bloom, William A. Kloeb.

CINCINNATI, OHIO—The Merkhofer Electric Works. $10,000. Incorporators: Charles W. Rattermann, Jacob Merkhofer, Carry W. Gillispie, Lewis H. Meyers, A. J. Merkhofer.

EAST ORANGE, N. J.—American Orderphone Company. $200,000. Incorporators: Jefferson D. Hobbs, Henry H. Dreyer, W. V. Ruton, Lawrence E. Taft, Jerome D. Gedney.

MADISON, WIS.—Fox & Callahan Phone-Alarm and Electrical Supply Company. $50,000. Incorporators: Benjamin O. Fox, John D. Callahan, Thomas E. Callahan and W. J. Delaney.

DAYTON, OHIO—The Cincinnati & Northeastern Traction Company. $15,000. Incorporators: Dennis Dwyer, Albert Emanuel, Charles T. McCrea, Charles L. McCrea and B. M. Hopkins.

INDIANAPOLIS, IND.—The South Bend Northern Railway Company. $10,000. Directors: Clyde Smith, Edward T. Gaffney, William W. Babcock, C. H. Sandage and Dermas D. Bates.

MINNEAPOLIS, MINN.—The Wheaton Electric Light Company. $25,000. Incorporators: W. I. Gray, W. W. Bardwell, M. Le Visconte, of Minneapolis, and F. W. Murphy and M. J. Jacobson, of Wheaton.

BUFFALO, N. Y.—Grand Island Telephone Company. $10,000. Directors: Josiah Jewett, Jr., Frederick H. Williams, John P. Williams, John V. Bedell, Josiah P. Wright, J. Boardman Scovell, Francis J. Airey.

FARGO, N. D.—The Fargo & Moorehead Street Railway Company. $250,000. Incorporators: M. E. McDonald, George H. Rice, T. C. Van Storch and E. W. Larned, of Scranton, Pa., and F. B. Morrill and W. C. MacFadden, of Fargo.

SAN FRANCISCO, CAL.—The Brandy Creek Water, Light and Power Company. $250,000. Directors: W. A. Hall, Oakland; John M. Gardner, Los Angeles; W. M. Sheldon, Los Angeles; F. M. Archer, Redding; James H. Devereaux, Aspen, Col.

COLORADO SPRINGS, COL.—Electric and Hydraulic Company. $100,000. Incorporators: Leonard E. Curtis, Henry Hire and Irving W. Bonbright, who are named as the directors for the first year, together with John Hays Hammond, Charles A. Coffin, John S. Bartlett and H. G. Lunt.

HOUGHTON, MICH.—The Houghton County Electric Light Company. $1,300,000. Stockholders: Lawrence A. Ford, Beverly, Mass.; Edwin S. Webster, Newton; Eliot Wadsworth, Boston; Henry G. Bradlee, Brookline; A. Stuart Pratt, Newton; John W. Hallowell, Medford; Henry B. Sawyer, Newton; Russell Robb, Concord; Guy E. Tripp, Boston; Francis J. Hovey, Hingham. Directors: Edwin S. Webster, Eliot Wadsworth, Henry G. Bradlee, A. Stuart Pratt, John W. Hallowell, Henry B. Sawyer, Russell Robb, Guy E. Tripp and Francis J. Hovey.

AUTOMOBILE NOTE.

NEW CUSTOM RULES FOR AUTOMOBILES—The American Automobile Association is distributing a circular letter to its members, stating that under the special Treasury Department regulations an American-made automobile may be taken abroad and brought back free of duty on its owner obtaining an outward-bound clearance before his departure, and an inward-bound clearance before his return to this country. An imported automobile may be taken out of the country and returned again provided it be registered at the custom house before being taken out of the country. The privilege hitherto enjoyed by foreign cycling tourists of entering their machines free of duty for temporary use, not to exceed three months, has been extended to automobilists. A bond must be given by the tourists, however, covering a penalty of double the estimated duties. An American traveler abroad is not deemed a tourist, and under this regulation any attachments or improved additions to an American-made or imported machine made while abroad will render the owner liable for duty.

ELECTRIC LIGHTING.

PONTIAC, MICH.—The Pontiac Standard Lighting Company has secured a contract to light the city for a period of two years.

SPARTA, GA.—The town of Sparta is considering the installation of an electric light plant. The plant will probably be owned by a stock company composed of a few citizens of the town.

MONESSEN, PA.—A number of business men of this town have organized a company, and will apply for a franchise to furnish the city with electric lights. If the same is granted, work will begin immediately.

WILLIAMSPORT, PA.—The South Williamsport council has awarded the contract for street lighting to the Lycoming Electric Company. The contract is for one year, with the option of the borough to continue it three years.

PHILADELPHIA, PA.—Cramp & Company have invited subbids for a big power plant for the Lehigh Valley Traction Company at Allentown. It will be of brick and steel, and will be one story high, to measure 118 by 169 feet.

CAZENOVIA, N. Y.—The business of the Union Electric Company has been purchased by local capitalists, who will take possession October 1. The company will be capitalized at $25,000. Many improvements are contemplated.

RAVENNA, OHIO—The Colonial Electric Company at its annual meeting held recently elected the following directors: T. H. Gillmer, E. W. Gillmer, E. E. Roberts, W. C. Ward, Warren; Wick C. Gans, Youngstown, and J. B. Estabrook, Ravenna.

BAY CITY, MICH.—A company of local capitalists has organized the Boulder Creek Milling and Power Company, with a capital of $2,000,000. The company proposes to erect and operate a plant on Boulder Creek, Col., for the purpose of furnishing power to mining industries.

CINCINNATI, OHIO—The councils of Lockland and Wyoming have approved of the transfer of the franchise of the old Wyoming electric plant to the Cincinnati Gas and Electric Company, and the latter company has taken charge. The gas company will remodel the plant and use it as a power station for the villages in the Mill Creek Valley.

WAUKEGAN, ILL.—The Waukegan Electric Light Company is now in the hands of Samuel Insull, president of the Chicago Edison Company. The company will be changed from a Wisconsin to an Illinois corporation. This will be done, it is said, for the purpose of financing a scheme to build an electric railway from Gray's Lake to Waukegan.

MILWAUKEE, WIS.—The Watertown Electric Light Company's plant has been sold to the Watertown Electric Company. The new owners are residents of this city and Grand Rapids. The officers are: President, F. E. Woodard, Watertown; vice-president, William Scott, Grand Rapids; secretary and manager, P. L. Utley, Grand Rapids; treasurer, W. H. Woodard, Watertown.

ALTOONA, PA.—The new Citizens' Electric Light, Heating and Power Company will at once begin the erection of a large plant. The officers of the company are as follows: President and general manager, S. S. Reighard; vice-president, Carl Olmes; secretary, George C. Kelchner. The directors are: Carl Olmes, I. C. Mishler, C. W. Moore, S. S. Reighard, T. M. Biddle, W. W. Murray and C. E. Wolf.

YORK, PA.—Three very large electrical enterprises have been started on the Susquehanna River, within twenty miles of this city. The first is at Conowingo Falls, which will generate 35,000 horse-power. The company has been capitalized at $4,000,000. B. Harvey Welsh, of Philadelphia, is the hydraulic engineer. The object is to send power to Wilmington and Chester. A second plant will be built at Peachbottom and McCall's Ferry, where it is proposed to generate 40,000 horse-power. The company has been capitalized at $10,000,000, David Warfield, of Baltimore, being the president. The current will be distributed to Baltimore and vicinity. A third plant will be erected at York Furnace by the American Pipe Company, of Philadelphia. The company will be capitalized at $5,000,000, and it is proposed to generate 40,000 horse-power. Surveys are now being made.

ELECTRIC RAILWAYS.

ONEIDA, N. Y.—Franchises have been granted to both the C. & M. Trolley Company and the Oneida Railway Company to cross Wood River and thence to Sylvan Beach.

BALTIMORE, MD.—It is reported that an electric line will be built across Willoughby Bay, opposite Old Point, from Ocean View to Sewell's Point, giving Newport News a quicker route to Ocean View.

HOOSICK, N. Y.—The highway commissioners have granted the application of the Bennington & Hoosac Valley Railroad for permission to extend its line through the town. The additional track will be twelve miles long.

PORTLAND, IND.—At a special meeting of the city council it was decided to grant a franchise to the Muncie & Portland Traction Company. This provides for a city street railway and interurban system to be completed within two years.

PHILADELPHIA, PA.—The entire capital stock of the new Baltimore & Chestertown Railway Company has been subscribed, the amount being $75,000. As soon as the company is organized the contract for the trolley line between Chestertown, Rock Hill and Tolchester Beach will be awarded.

WINCHESTER, VA.—It has been announced that Mr. Patrick Russ, the millionaire capitalist of Harrisburg, Pa., will erect a trolley line between Winchester and Berryville. The distance is eleven miles, and the cost will be $100,000. It will be the first trolley line to be built in the Shenandoah Valley.

OYSTER BAY, L. I.—It is now almost certain that a trolley line is to be built to this village through the chain of villages between here and Mineola, at which point it will connect with the existing cross-island line. Starting from Mineola, the line will run through East Williston, Roslyn, Glen Head, Glenwood, Sea Cliff, Glen Cove and Locust Valley to the railroad station here.

STEUBENVILLE, OHIO—The Steubenville, Mingo & Ohio Valley Traction Company has been granted a franchise giving the company the right to construct an electric line along the east side of the new county road from the city limits to Mingo. Work will begin within six months, and it is estimated that the cost of the retaining walls and other masonry alone will be at least $200,000. The franchise is for fifty years from and after the construction of the road, which must be built within four years.

NATCHEZ, MISS.—Nearly all the stock of the Natchez Electric Street Railway and Power Company has been sold to W. B. Rogers, of New Orleans, and S. S. Bullis. The company operates six miles of track, and the stock paid handsome dividends to the old stockholders. The new stockholders elected the following directors: W. B. Rogers, W. R. Moorman and J. H. Levy, New Orleans; S. S. Bullis, E. H. Ratcliff, Sim H. Lowenburg and James W. Lambert, of Natchez. The officers elected are: W. B. Rogers, president; James W. Lambert, vice-president; W. R. Moorman, secretary and treasurer. At a meeting of the stockholders it was decided to extend the lines to the New Orleans and Northwestern depot, and also to the eastern part of the city.

CLEVELAND, OHIO—It is stated that the Lake Shore Electric Railway Company will be reorganized, and the receiver relieved of his duties. The reorganization plan provides for a $6,000,000 general consolidated mortgage. Under this there will be an issue of $4,000,000 of first consolidated bonds, of which $750,000 will be used to take up the Lorain & Cleveland Company's outstanding bonds, and $1,500,000 will be used to retire the bonds of the Toledo, Fremont & Norwalk Line. The remaining $1,750,000 will be purchased by a syndicate of Cleveland banks and trust companies at $90 and accrued interest. This will give the company $1,575,000 in cash that will be used to take up and retire Sandusky & Interurban bonds to the amount of half a million receivers' certificates on the Lake Shore Electric Railway and construction notes, leaving a cash balance of more than $350,000. Of the additional $2,000,000 to be issued as general bonds, one-half will be exchanged for the outstanding Lake Shore Electric Railway bonds, nearly all of which are held by the Everett-Moore Syndicate. One million dollars' worth of bonds will be kept in the treasury.

INDUSTRIAL ITEMS.

THE SUNLIGHT LAVA MANUFACTURING COMPANY, Chattanooga, Tenn., has recently printed a bulletin illustrating the various types of Sunlight burners. The company manufactures this product in several forms of burners and specialties that may be adaptable for electric lighting and gas service.

THE UNION SWITCH AND SIGNALING COMPANY, Swissdale, Pa., is distributing a catalogue and price list of interlockings and signaling devices. This is section No. 5 of a series of catalogues which this company is publishing from time to time, and is particularly descriptive of station signals used as train order or telegraph block signals.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, has ready for distribution four bulletins, Nos. 1002, 1003, 1012, 1013. These describe, respectively, type N motors, direct-current multipolar, marine lighting and power sets; type H, direct-current multipolar motors, and types H and H I belt-current multipolar generators. These may be had upon application to the company.

THE FRANKLIN INSTITUTE, Philadelphia, Pa., has arranged an excellent programme for September and October. On Thursday, September 25, Professor George F. Stradlung lectured upon "The Ionization of Gases." On Thursday, October 2, Doctor Merritt Matthews will lecture on "The Scientific and Industrial Development of Artificial Indigo." On Thursday, October 9, Mr. Joseph Sachs, Hartford, Ct., will lecture on "Electric Fuse Protective Devices."

THE HYDRO DOUBLE BATTERY COMPANY, 70 and 72 Reade street, New York city, manufacturer of semi-dry batteries, has had a receiver appointed in the person of Mr. Robert J. Raymond. This step is taken in order to reorganize the company, and the business will in all probability go on. The company is a New Jersey corporation, organized in January, 1901, with a capital stock of $1,000,000, to operate in the United States under a German patent for batteries. A number of prominent men are interested in the company.

THE STANLEY ELECTRICAL MANUFACTURING COMPANY, Pittsfield, Mass., has assigned the second floor of the Gatehouse for club purposes to the employés. A club has been organized to be known as the Stanley Club, the object being the betterment of the individuals' interests of all employés in an intellectual, physical, moral and material way. Committees have been formed to consider the following subjects: Employés' insurance, employés' reading room, a series of lectures for the winter months, grievances, athletics and any other temporary or permanent committees considered desirable.

THE PROMETHEUS ELECTRIC COMPANY, 60 Reade street, New York city, manufacturer of the well-known "Prometheus" electric heating and cooking apparatus, reports that its goods are finding much favor and, judging from the number of orders received, it is apparent that the public are realizing the great advantages and high efficiency of the "Prometheus" apparatus. A fine catalogue is now in press and will be ready in about ten days. It is a very elaborate production and portrays a full line of domestic and commercial heating apparatus and rheostats. A copy of the catalogue will be sent to any one on application.

THE SMITH & HEMENWAY COMPANY, 296 Broadway, New York city, has just issued the fourth edition of the "Green Book of Hardware Specialties." This book is considerably larger than the last one, and contains 144 pages of very interesting matter, and is illustrated throughout by a number of half-tones. These are illustrations of all the articles manufactured by the Smith & Hemenway Company and the Utica Drop Forge and Tool Company. The book is printed on light green paper, the letter-press being in black ink, and an artistic border is used to embellish each page. This book will be sent to parties interested on application to the company.

THE OTIS ELEVATOR COMPANY, New York city, has closed recently probably the largest elevator contract ever awarded. This is with the Metropolitan Life Insurance Company, for the additions to the new building at Fourth Avenue, Twenty-third and Twenty-fourth streets, New York city. The new equipment consists of twenty-three high-pressure passenger elevators, four hydraulic freight elevators, and two electric passenger elevators, and contemplates converting the thirteen passenger elevators in the original building so as to operate them at the increased pressure. The plant when completed will consist of forty hydraulic elevators, operated from one station. Messrs. N. LeBrun & Sons are the architects, and V. J. Heddon & Sons, the builders.

THE BRIDGEPORT BRASS COMPANY, 19 Murray street, New York city, is the manufacturer of "Phono-Electric" wire. This wire has received the endorsement of prominent electrical experts, and the company states is meeting with a very popular demand. "Phono-Electric" wire, it is claimed, has a very high elastic limit, and will stand the vicissitudes of outdoor exposure. The company will take pleasure in distributing literature showing the increase in efficiency of lines constructed from "Phono-Electric" wire. The principal features of this wire are in its ability to transmit vibrations so as to articulate with great clearness either over short or long distances, its freedom from annoying breakdowns, and the great decrease of maintenance expense with installations of any length.

THE CONSOLIDATED AXLE LIGHT SYSTEM of electric lights and fans has been adopted by the Southern Pacific Railway Company, in conjunction with the Rock Island, for electrically lighting and ventilating all of the new cars that consititute the Golden State Limited, which goes into service between Chicago and California on November 1. This system is also in use on the Twentieth Century Limited, of the New York Central & Lake Shore, the Pennsylvania Limited, and on many other leading railway lines, as well as on private Pullman cars. One of the advantages of the consolidated axle light system is that each car carries its own lighting apparatus, making its own electricity as it moves with the power taken from the revolving car axle, and storing up sufficient charge in batteries underneath the car to keep up the illumination while the car is not running. This system is installed by the Consolidated Railway, Electric Light and Equipment Company, American Surety Building, New York city.

THE BUNNELL CONSOLIDATION—Through the law office of Mr. Albert J. Wise, 25 Pine street, New York, announcement is made of the purchase of J. H. Bunnell & Company by the Bunnell Telegraphic and Electric Company, both of New York. It is announced that Mr. Charles McLaughlin, of J. H. Bunnell & Company, will retire after the consolidation is perfected and the consolidated companies will be under the general supervision of Messrs. Albert J. Wise and Morris Wise. Mr. Albert J. Wise is president and treasurer, and Mr. A. U. Hass, secretary. The Bunnell Telegraphic and Electric Company has operated a well-equipped manufacturing plant at Milford, Ct., which it purchased from the National Electric Manufacturing Company, and also a manufacturing plant at 114 and 116 Beekman street, New York, in which building it maintains its sales offices. The name "Bunnell" has long been associated with telegraphic apparatus, and the production of this apparatus will continue in the future to be a prominent feature for the corporation. The company also will be a large dealer in general electrical supplies.

THE HAINES & NOYES COMPANY, Chicago, Ill., manufacturer of telephone apparatus, announces that it has recently opened an eastern office, under the management of Mr. J. A. Mears and Mr. F. H. Schlesinger, at 220 Broadway, New York city. This office will take care of any eastern business, and all prices in this territory will be F. O. B., New York. Mr. Schlesinger was formerly associated with Stanley & Patterson, as well as with the Peru Electric Manufacturing Company. Mr. Mears is a well-known business man of New York city. The Haines & Noyes Company wishes to state that all correspondence coming from the East should be directed to its New York office. Inasmuch as both Mr. Schlesinger and Mr. Mears are practical electrical men, as well as telephone men, the company feels sure that all prospective customers, as well as former customers, will be well taken care of. The company has made a large number of important installations during the past month, among which may be mentioned a private telephone system in the new residence of Marshall Field, Chicago, Ill., a large telephone system throughout the McCoy Hotel, Chicago; a 400-drop central energy board and telephone apparatus for East Aurora, Ill.; a large shipment of telephones to the Companie Industriale, Mexico, and the Electrical Construction Company, London; also the East Aurora Hospital, through the M. B. Austin Electric Company, Chicago, Ill. The company announces that the September business has been the largest on record.